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THE JOURNAL OF SCIENCE.

Vol. VI. (Third Series.)

1884.

THE

JOURNAL OF SCIENCE,

AND ANNALS OF

ASTRONOMY, BIOLOGY, GEOLOGY, INDUSTRIAL ARTS, MANUFACTURES, AND TECHNOLOGY.

(MONTHLY, FORMERLY "THE QUARTERLY JOURNAL OF SCIENCE.")

VOL. VI. (THIRD SERIES.)
VOL. XXI. (O.S.)

LONDON:
3, HORSE-SHOE COURT, LUDGATE HILL.

MDCCCLXXXIV.

TWENTY-FIRST YEAR OF PUBLICATION.

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No. CXXI.

JANUARY 1884.

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Where Communications for the Editor and Books for Review may be addressed.

PRICE ONE SHILLING AND SIXPENCE

THE

JOURNAL OF SCIENCE.

JANUARY, 1884.

I. EARTHQUAKES AND ELECTRICITY.

By Colonel Arthur Parnell, late Royal Engineers.

(Concluded from vol. v., page 706.)

In "A Practical Treatise on Lightning Protection," by Henry W. Spang (Philadelphia, 1877), it is stated that Mr. Cromwell Varley, F.R.S. (whose lamented death has recently taken place), was of opinion that some earthquakes are due to subterraneous electrical discharges. He had found that powerful positive currents rushed through the Anglo-American cables towards England a few minutes before and a few minutes after the shocks of March 17th, 1871 (p. 29).

In "Nature" (No. 247, vol. x., 1874) Mr. H. H. Howorth expresses his opinion that the earth is shrinking about its equatorial region, and is being thrust out in the direction of the Poles; and he thinks that the distribution of this force may correspond with that of terrestrial magnetism. He quotes from Dr. Zöllner's paper in the "Philosophical Magazine," wherein it is stated that Kriel has given many instances of the coincidence of earthquakes with magnetic disturbances. Volcanoes are, according to Mr. Howorth, the mediate results of the shrinking of the earth; "earthquakes, on the contrary, are its immediate results, and go far to prove that terrestrial magnetism is to be correlated with the force which is shrinking the earth."

The article in the "Quarterly Review" for July, 1881, already mentioned, states that the most certain characters and accompaniments of earthquakes appear to be their

suddenness, the stifling heat and electric state of the atmosphere, and the sudden roar as of distant artillery. Dr. Schmidt, the Government Astronomer at Athens, in his researches on the Grecian earthquakes of 1840 to 1878, arrives at the result that the great ones had almost invariably a direction from N.E. to S.W. The reviewer says that the same fact has also been noticed in regard to severe shocks in America in 1870; and he then asks "Is not this the line of path habitually followed by electric currents?" After further discussion on the physical action of earthquakes, he says—"Considering the irresistible force, the unmeasured rapidity, the quick repetition, and the long duration of the shocks, what known agent in Nature, we would ask, except Electricity, is capable of producing at the same time such singular effects in the sea and such tremendous results on land?" Lyell and other authors have mentioned, but without laying on the occurrence the stress it deserves, the state of the atmosphere before an earthquake as densely charged with electricity. "The vicinity of hot springs, volcanoes, and mud lakes, regions of intense heat and centres of the electric influence, are the special haunts of the earthquake, and Science has pretty well proved that heat and electricity are convertible." All the circumstances inseparably connected with earthquakes point to the conclusion "that an earthquake is the result of discharges of terrestrial electricity accumulated in the bowels of the earth, which we know to be a reservoir of electric matter." An earthquake shock "is a direct blow not differing probably from that of a lightning stroke." "Even if it be proved that the solid strata beneath the surface and the mountain masses above it are unfavourable to the transmission of electric energy, there are plenty of cracks and fissures in its solid substances through which it may shoot forth. In the waters of ocean it finds a ready conductor, which accounts for the way in which ships on the sea are affected by it."

The attention of electrical engineers is invited to consider whether it may not be possible to invent some species of apparatus "capable of averting the calamity from its habitual haunts." The reviewer hopes that men of Science intent upon the collection and storage of electric force will not neglect "that storehouse of unlimited energy already filled within the bosom of the earth," and he trusts that they may be able to devise means for preventing the fearful disasters liable to be occasioned by earthquake shocks. We have given but a brief summary of the salient points of this cogently-reasoned paper, which deals with the subject in a

very comprehensive manner, and is especially powerful in treating on the geological portion of the question.

In April, 1882, the present writer published a small work on "The Action of Lightning," completed by him in April, 1881. He was unfortunately unaware of the researches concerning the association of electricity and earthquakes made by the authors he has mentioned, or the short allusions made to the subject in his work would probably have been more copious and decided. He ventures, however, to re-submit these few references as being perhaps entitled, in their measure, to take part as links in the chain of literary effort under investigation. The passages are as follows:—"We appear to have *primâ facie* grounds for believing that the earth's surface is really the collecting plate of the terrestrial condenser; . . . but the questions now arise, what is the original source of the earth's electricity? and how does its surface collect it? In our present state of knowledge it seems to be impossible to get beyond conjecture in replying to such questions. Supposing, however, that we take up the opposite view, that the clouds form the collecting plate, the task of attempting to prove how they originate and collect their electricity would appear to be even more hopeless; for although we reasonably infer that the clouds are collectors of electricity, we do not know the fact for certain. . . . But we do know with certainty several important facts regarding the earth's electrical constitution; one is that it is a great holder of electricity; . . . another, that terrestrial disturbances, such as waterspouts, earthquakes, and volcanic eruptions, are connected with the actions of electricity or magnetism." . . . "As to how the earth . . . became a magnet we are practically in total ignorance. The fact, however, that it is *simultaneously both a holder of electricity and a magnet* is well worthy of attention; and so also is the fact that phenomena undoubtedly electrical, *i.e.*, earth-currents and auroræ, are invariably accompanied by magnetic disturbances." . . . "May we not conceive the subtle force usually called magnetism to be nothing but electricity, *i.e.*, *electricity bound or manifested in a peculiar manner*, and magnetism itself as only a *property* or influence . . . appertaining to certain bodies and permitting this particular manifestation?" . . . "On this principle, then, the earth is a magnetic body like steel or iron, and what is known as its magnetism becomes an additional proof of the presence and activity of its *electricity*, and strengthens the probability that the globe is itself the *originator of thunderstorms and of all other electrical phenomena*

known to occur in connection with it. That the separated agencies composing this electricity should be in constant motion in the magnetic field or orb from the Equator towards the Poles is what is to be expected; . . . hence . . . we have manifestations of motion (rendered irregular by induction and by geological causes) in the shape of *earth-currents.* The polar accumulations of electricity . . . would explain the *attraction of the earth's poles* on those of other magnets. To the same fact of dense accumulation of electricity at or near the magnetic and terrestrial poles . . . would be attributed the manifestations of silent continuous discharges . . . seen under the form of *auroræ.* And it is conceivable that the electricities, in their motions . . . towards the poles, are occasionally forced . . . to accumulate for a time at certain places on the surface; and when this should occur in regions where clouds . . . were frequently present, the necessary conditions for the development of *thunderstorms* would apparently be obtained. Lastly, if the . . . accumulations should occur in certain portions of the earth's crust . . . insulated from each other, and below though not far removed from the surface, and especially in regions where clouds . . . were habitually absent (as in Chili and Lower Peru), there would appear to be possible causes for the occurrence of earth explosions manifested by *earthquakes*" (pp. 156—160). In regard to the term *explosion* here used the writer is now inclined to consider the nature of an earthquake discharge as an *electrical leak* rather than as an electrical explosion.

In the "Athenæum" of July 8th, 1882, a review of the last-mentioned work was given. The reviewer noticed the portions relative to terrestrial electricity in the following terms:—"The earth-sprung lightnings which so constantly form an attendant phenomenon on volcanic eruptions, and the subterranean thunder which at times resembles the artillery fire of a naval engagement, are at once facts that support the view given in this book of the functions of the terrestrial condenser, and hints that the diligent pursuit of the enquiry may yield much valuable information as to the general theory of electric storms, aërial, super-terrestrial, or sub-terrestrial." . . . "It is from the co-ordination of the indications given by the barometer, the seismometer, and the various appliances for measuring electric and magnetic force and direction, that we must hope to arrive in due time at the true theory of electric storms, of which we take thunder and lightning to be one form and earthquake another."

The last extract in our series is one from an article on "The City of Earthquakes," in the "Atlantic Monthly Magazine" for March, 1883, by Mr. Horace D. Warner, a Civil Engineer who was present at Caracas during the last earthquake there, on September 6th, 1882. It appears that it was accompanied by a coast wave, and that serious damage was almost wholly confined to the river suburb, the higher portions of the town, built on a rocky substratum, being untouched. He says that "a native of Venezuela would laugh at the idea that a *terremoto* is an upheaval of the ground. The movement of dislodged rocks, the disjointment of house-walls and their way of falling, the motions of a tidal wave during the progress of an earthquake, all prove that the shock is a lateral push." This statement seems to corroborate the idea already suggested, in reference to the writings of Mr. William Nicholson in 1787, that the shock is probably a discharge not of the concentrated nature of an explosion, but rather that due to a *sudden escape of accumulated force from the ground over an area of some extent,*—a theory to which the facts attendant on electrical leak discharges are eminently favourable.

In order to strengthen the idea of the electrical origin of earthquakes we will now submit a list of some of those events the records of which show that they were preceded, accompanied, or followed, by storms of thunder and lightning. The incidents, unless otherwise annotated, are selected from Mallet's Reports.

Preceded by Thunderstorms (6 cases).

1728. August 3. Berne.
1784. April 1. Calabria.
1799. December 11. Silesia.
1828. Jan. 16. Hungary.
1830. June 26. Honan, China.
1881. July 22. Morges, Switzerland. (Standard, July 23, 1881.)

Accompanied by Thunderstorms (45 cases).

1606 (B.C.). Mount Sinai.
365 (A.D.). July 21. Greece and Asia Minor.
557. Constantinople and Antioch.
855. Mayence.
1062. Switzerland.
1091. Angers.
1117. Jan. Upper Italy.
1117. May. Liège.
1138. Wurzburg.
1274. England.
1365. Bologna.
1530. Flanders.
1560. Dec. 13. Vienna.
1563. Belgium.

1578. Ofen, Hungary.
1583. Mans, France.
1697. March. Transylvania.
1704. Nov. 4. Switzerland.
1711. May 17. Bergen-op-Zoom.
1715. June 12. Saxony.
1719. March 6. Champagne, France.
1720. June 1. Freiberg.
1737. May 17, 18, and 21. Suabia.
1752. Sept. 9. Rampiz on the Oder.
1765. July 23. West Bothnia, Sweden.
1778. Nov. 18. Trieste.
1784. Jan. 17. La Rochelle, France.
1786. Dec. 25. Rimini, Italy.
1791. Dec. 2. Zante.
1792. Feb. 13. Norway.
1799. Feb. 21. Frankfort-on-the-Maine.
1799. Nov. 4. Cumana, S. America.
1808. April 11 and 21. Piedmont.
1813. Sept. 22. Lower Engadine.
1813. December. Epirus.
1821. October 22. Comrie, Perthshire.
1829. July 24. Murcia, Spain.
1837. Aug. 9. Mexico.
1838. Feb. 28. Lisbon.
1819. June 16. Masulipatam, India. (Brit. Assoc. Rep., 1855, p. 98.)
1693. January 11. Catania. (Phil. Trans. Hutt. Abr., iii., p. 556.)
1819. Jan. 28. St. Ubes, Portugal. (Howard's Climate of London, ii., 435.)
1824. July 13. Christ Church, Hampshire.
1843. July 5. Penzance. (B. A. R., 1845, p. 20.)
1845. June 13. Kent. (B. A. R., 1845, p. 20.)

The year 1750—during which, on September 30th, the shock at Daventry, in Northamptonshire, occurred—was remarkable for thunder and lightning throughout England (Priestley, Hist., 356). In 1822 "an extraordinary number of violent thunderstorms, accompanied by earthquakes and simultaneous eruptions of Mount Vesuvius," occurred in France and over a great part of the Continent (Anderson on Lightning, p. 76). In July, 1829, earthquakes occurred in Hungary and in Spain, and remarkable thunderstorms in many parts of Europe (Mallet). In 1880, and again in 1883, thunderstorms and earthquakes were very prevalent in many countries.

Followed by Thunderstorms (22 cases).

1622. March. Upper and Lower Engadine.
1626. Sept. 6. La Capitanata and Naples.
1628. Mecklenburg.
1661. March 27. The Valais, Switzerland.
1662. September. Rome.

1680. July 24. Orbes, Switzerland.
1750. June 24. Munich.
1752. April 15. Stavanger, Norway.
1754. Sept. 6. Constantinople.
1760. Aug. 17. Salonica.
1769. Nov. 18. Avignon.
1814. March 8. Nantes.
1821. Oct. 24. Sienna.
1823. March 5. Palermo.
1824. July 18. Gotha.
1824. Sept. 7. Guadaloupe.
1828. April 11. Venice.
1834. October 6. Cartagena, Spain.
1785. July 19. Coldstream, Berwickshire. (Phil. Tr., lxxvii.)
1864. August 21. Lewes, Sussex. (B. A. R., 1864, Trans., 16.)
1810. Nov. 29. H.M.S. *Salsette*, 10 leagues S. of Cape Matapan, Mediterranean Sea. (Edin. Journ. Sc., 1826, v., 222.)
1883. July 28. Ischia, Bay of Naples. A violent thunderstorm at Naples on July 29th. (Times, July 31, 1883.)

To the above lists it may perhaps be interesting to add a few meteorological statistics, gathered from the records of earthquake incidents, collected by the writer for analysis, up to the present date. Most of the manifestations named are probably closely connected with the action of terrestrial electricity. It is to be understood that either shortly before, or during, or shortly after the occurrence of shocks, these additional phenomena were among the attendant circumstances. The number of separate earthquake cases from which they are gleaned amounts to 490.

	No. of cases.
Thunder, detonations, and rumblings ...	156
Isolated rushes or currents of wind, or hissing sounds, giving the idea of an escape of force	31
Waves or commotions of the sea	28
Auroræ	23
Meteors	73
Ignes fatui	2
Lightning flashes in the atmosphere (exclusive of thunderstorms)	15
Flames seen to issue from fissures ...	10
Magnetic disturbances	22
Tempests, hail, and rain (exclusive of thunderstorms	62
Whirlwinds	7
Snowstorms	8

We propose to conclude our paper with a few remarks on the subject of the prevention of earthquakes. The time seems to have arrived when it behoves philosophers and physicists to devote their energies in a far greater degree than has hitherto been the case to the endeavour to prevent the occurrence of dangerous physical phenomena. The scientific tendency of the time has hitherto been principally to record and to measure the effects of these catastrophes. But it appears quite within the bounds of possibility for learned men, carried away by an abstract love of their knowledge, to push their efforts in this direction a little too far. Ingenious instruments have been devised not only for the purpose of foretelling the approach of earthquakes, but also with the object of accurately measuring their intensity, rate of transit, and other (by no means unimportant) features of their operation. But *cui bono* these elaborate contrivances so far as tending to mitigate the terrible power of the convulsions? Without wishing to undervalue in the smallest degree the great labours and researches of Prof. Palmieri, the Italian physicist who superintends the well-fitted observatory at Mount Vesuvius, designed to give warning of coming earthquakes in the region of the Bay of Naples, can it be said that a single human life, or even a single building, has been saved from loss by earthquake since its establishment? Within a space of little more than two years Ischia has experienced two severe earthquakes. By the first—that of March 5th, 1881—it appears that 114 lives were lost, 289 houses were destroyed, 260 families were rendered homeless, and property was ruined amounting in value to about £40,000. By the second—that of July 28th, 1883—1990 lives have been lost, 374 persons have been injured, and four towns and villages have been practically reduced to heaps of stone. Now it is distinctly recorded in a trustworthy source of information ("Nature," August 9, 1883) that Prof. Palmieri's delicate seismometers at Vesuvius recorded no tremors whatever previous to the fatal shock of last July. But did they even record any warning signs previous to that of March, 1881? Or, if they did, was the record of the slightest benefit?

Take another aspect of the question. By simply referring to the various illustrated periodicals of March, 1881, we see, with considerable accuracy, the nature of the buildings which by their toppling over were the immediate cause of the great loss of life that ensued. They are evidently substantial masonry edifices, ranging to as many as three and four storeys in height. Now the construction of such houses

in a place like Ischia, known to be liable to shocks, seems of itself to demonstrate a remarkable absence of reasoning power. But who would credit that after the catastrophe of March, 1881, not only were the untouched masonry buildings not pulled down or not disused, but the ruined buildings were actually rebuilt in their previous lofty fashion? But this is what has really taken place: the lessons taught by the March slaughter have been positively *nil*. One would have thought that after that event the least the Italian philosophers could have done would have been to insist on all buildings in Ischia being constructed of wood (or of light iron), and only of one storey. But they appear to have neglected their obvious duty in this respect; the Public Works authorities seem to have displayed to an abnormal extent the *laissez aller* qualities proverbially attributed to the denizens of Southern Europe, and the result has been the great human sacrifice that has recently taken place. But if the theory of the electrical origin of earthquakes cannot be proved to be the delusion of madmen, do not these successive Italian holocausts call for at least a careful examination, by bodies of men like the Academy of France or the Royal Society of England, of the facts and arguments brought forward by those who earnestly advocate this theory? Take the matter on this ground alone. If the electrical theory be accepted there is at least a *chance* of devising measures capable of tending to avert these disasters. After much reflection the writer is firmly convinced that simple and economical means could at once be tried which might (if experiments were patiently pursued) lead to the discovery of actual preventives to these dreadful plagues. But if the theories of steam, cooling, shrinking, subsidence, vibration, &c., be persistently believed in, what possible remedy ever *can* be obtained. From their very nature these theories cannot lead to any preventive measures ever being adopted. That, of all countries in the world, the one which contains the great Calabrian "earthquake battle-field,"—the one which from time immemorial has, owing to her soil's fearful shudderings, lost unnumbered sons and daughters, prematurely cut off from this bright earth in all their youth and pride,—the one which brought forth Galvani, Volta, and Beccaria, and made her colleges the very homes and nurseries of electricity,—that this country should neglect to apply electrical experiments towards the prevention of disasters, which all experience shows are at least intimately associated with known electrical phenomena, seems almost incredible. Let us cease to stigmatise earthquakes as

"mindless accidents of Nature"; rather let us consider them as wilful strokes of the Adversary, and let us ask for light wherewith to design measures that shall tend to render these deadly convulsions impossible.

II. CANINE INTELLIGENCE.

(Concluded from vol. v., p. 738.)

II.

NO one can have watched the ordinary life of dogs without observing for himself that much of their conduct is not merely the result of habit inherited or acquired, but is intelligent, original, and suited to the occasion. This is of course especially marked in specially clever dogs, but all dogs show it in a high degree. The other day I got over a fence which my dog could not get through; he immediately showed his intelligence by running along the fence for 60 yards or so, and finding out a place where he could scramble through. The *unintelligent* action would have been to jump at the impossible place for an hour or two. Not to attempt the clearly impossible is a marked sign of intelligence in dogs and men. "Happy they," says Goethe, "who soon detect the chasm that lies between their wishes and their powers."

It is not my intention, however, to give in this paper any special anecdotes illustrative of Canine Intelligence. To my mind the ordinary every-day intelligence of the dog is sufficiently convincing. When Pincher does not wait at the window for his master's return because he went out with a hand-bag, and therefore has gone to town for the night; when Sambo whines and is miserable because he sees my packed portmanteau in the hall, and knows that means some days absence; when Toby does not attempt to follow me because I have on a black hat and frock-coat; when Turk, anxious to be up to mischief, shams sleep, and then steals softly out of the room;—when ordinary commonplace dogs perform actions like these, and continually *modify their*

conduct according to circumstances, we cannot but call their actions intelligent.

Nor have I space to enter upon the emotional character of the dog. This, too, I must leave the reader to fill in from his own observation. What I wish to do now is to enquire whether we may apply the term *rational* to the actions of the dog? May we speak of Reason in the lower animals? Or must we speak of intelligence only, or intellect, and hold that man is the only rational creature? That, I think, depends entirely upon our definition of Reason. The word Reason is used in a wider and in a narrower sense. In the wider sense it is antithetical to Instinct; in the narrower, it is the process of abstract thought effected through the medium of signs written or spoken. If we accept the former, and regard a rational act as one performed *in special adaptation to special circumstances,* I do not see how the term rational can be denied to such acts as we see daily performed by dogs of very average ability. If we maintain the latter view, and hold that Reason is *abstract thought carried on by means of language,* I do not see how the term rational can be applied to any animal act whatever.

The question, however, arises how far we have any right to restrict the word Reason in this way? All processes of thought are carried on by association of ideas; and in the chain of association there may be links of all kinds furnished by all the senses we possess. Man adds to the natural links in this chain of association certain arbitrary symbols of his own manufacture; and we call these arbitrary symbols *words.* But does the introduction of these special links in the chain cause the association to differ in kind from that in which such links are absent? If it does, then we may fairly apply the term reason to this special form of mental action, and hold that reason is distinctive of man. But if *the nature of the association does not differ in kind,* then let us not deny to Diamond his share in the rational faculty which gave to his master his proud pre-eminence.

In this connection it is impossible to avoid some allusion to the question how far animals have the power of forming abstract ideas. Let us first hear what Mr. Romanes, a recognised authority, writes. "Give a cat or dog," he says, "some kind of meat or cake which the animal has never before met with, and the careful examination which the morsel undergoes before it is consigned to the mouth proves that the animal has properly abstract ideas of sweet, bitter, hot, nauseous, or, in general, good for eating and bad for eating,—*i.e.*, abstract ideas of quality as apart from the object

examined,—the motive of the examination clearly being to ascertain which general idea of quality is appropriate to the particular object examined." With this statement I cannot altogether agree. In the first place I do not like the use of the expressions "abstract ideas of quality" and "general ideas of quality" as synonymous; and, in the second place, if, as the words "apart from the object examined" seem to imply, Mr. Romanes wishes us to understand abstract ideas in what I regard as the true sense of this phrase, then I cannot agree that "the animal has properly abstract ideas." I do, most certainly, believe that the dog has the power of forming general ideas; but I do not believe that the dog, or any animal, has the power of forming abstract ideas properly so called.

Let me, however, show the sense in which I understand the terms general ideas and abstract ideas. I believe it to be the sense in which they are always used by Mr. Herbert Spencer. What we chiefly need now in our discussions of matters connected with this subject is greater precision in our use of such terms as these.

A general idea then is, as the word implies, opposed to that special idea which arises in the mind on sight of a particular object. If I look out of window I see a horse, and I have a special idea of this particular individual horse. (I use the word idea in each case merely to mark the opposition.) But you, my reader, who do not see that horse, have a general idea of horse called up in your mind by a certain printed word.

Now there can, I think, be little doubt that animals are perfectly well able to form general ideas of objects. See how a dog starts at the sound of a strange footstep. Surely we must suppose that the unusual footfall suggests the idea of a stranger by whom it is produced. But if of a stranger it must be general, not individual. So, too, with qualities. A strange piece of meat suggests an idea of taste, *as part of the total idea of the object;* and since the meat is of unknown and untried character, the suggested idea of taste must be general, and not particular. In this way the dog may be supposed to have general "ideas of sweet, bitter, hot, nauseous, and, in general, good for eating and bad for eating." But they are general ideas, not abstract.

What, then, are abstract ideas? Abstract ideas are ideas of qualities or relations isolated from their usual accompaniments. *The act of abstraction is the act of separating in thought qualities or relations which are inseparable in fact.* Thus we can form an abstract idea of roundness apart from any

objects which are round; we can form (and formulate) abstract ideas of numerical relations apart from the objects which enter into these relations, and we can frame and discuss abstract ideas of figure apart from the objects which exhibit this spatial relation. These abstract ideas may, moreover, like our ideas of objects (groups of qualities in natural combination), be either particular or general. The abstract idea of roundness, for example, is and must always be particular, for there are not different kinds of roundness which may give rise to a general idea of roundness. The abstract idea of a triangle, on the other hand, may be either particular, as in the case of an isosceles triangle, or general; the general abstract idea being a conception of that general relation to each other of three straight lines, without which no triangular figure can exist.

Note now the difference between the general ideas of sweet, bitter, &c., to which Mr. Romanes alludes, and the abstract ideas of sweetness, bitterness, and so forth. The ideas of sweet, bitter, &c., formed by a dog *are not isolated*; they form part and parcel of the conception of the object under examination. They are general because no special form of sweetness, bitterness, &c., can be called up in association with the other qualities of a hitherto unexplored object. But they are not "apart from the object examined." There is no separation in thought of the qualities of the object in question.

This separation, which I hold to be essential to an abstract idea properly so called, is, to quote the words of John Locke, "an excellency which the faculties of brutes do by no means attain to." It is only the human mind, and that mind in a somewhat advanced state, that can analyse an object (or group of qualities in natural combination) into its component parts, and then consider certain of those qualities to the exclusion of the others.

Man in fact does two things which no dog can do. By analysis he breaks up his conception of an object into separate components, and studies those components by themselves; and by synthesis he builds up a more comprehensive conception, adding fresh components which he has discovered by study and reflection. It is by the symbolic use of words that he is enabled to carry on his analysis; and, on the other hand, as I have said elsewhere, "it is the *word* that groups around itself not only the little cluster of associated ideas which make up the ordinary unreflecting conception of the object it symbolises, but also all those further ideas which are the result of scientific study. The word is the

peg upon which we hang those abstract qualities which by means of words we have isolated."

But it may be said that, although their language differs from ours, animals, too, have their language,—imperfect it is true, but still a language of their own,—a means of communication with their fellows; and this is perfectly true. It is true, too, that my dogs can understand much that I say to them—can understand *my* language. But all that a dog can communicate to his fellow—all that I can communicate to my dog—is a sign which he has learnt to associate with certain feelings or with certain actions to be performed. The communication deals, too, with immediate feeling or action; its sphere is the here and the now. There can be no doubt that dogs associate with barking in certain tones special emotional states in their companions. In fact it is probable that dogs can in this way communicate to each other a wide range of states of feeling. But these states are present states, not states past or future; they are their own states, not the states of others. A dog can call his companion's attention to a worriable cat, or he may have his attention roused by my exclaiming "Cat." But no dog could tell his companion of the successful "worry" he had just enjoyed, or suggest that they should go out for a "worry" to-morrow morning. And here we come upon what seems to me the fact which raises man so immeasurably above the level of the brute. *The brute has to be contented with the experience he inherits or individually acquires. Man, through language spoken and written, profits by the experience of his fellows.* Even the most savage tribe has traditions extending back to the father's father. And the civilised man—has he not in his libraries the recorded results of many centuries of ever-widening experience and ever-deepening thought? Thus it is that language has made us men; by means of language, and language alone, has human thought become possible. This it is which has placed so enormous a gap between the mind of man and the mind of the dog. Through language each human being becomes the inheritor of the accumulated thought and experience of the whole human race; through language has the higher abstract thought become possible.

Still the question remains, How far can we comprehend the nature of canine thought? There is only one way, as it seems to me, of getting at any sort of answer to this question; and that way is, by patiently and carefully considering what is the nature of the subjects on which that thought is exercised. To get any accurate notion of our

neighbour's mental calibre we endeavour to ascertain what are the subjects to which his mental activity is devoted; and to get any accurate notion of a dog's mental calibre we must surely do the same.

All I can do here, however, is to point out one or two tolerably obvious general considerations. In the first place we must not forget that it is the primary aim of cognition to serve as a guide to action, and that conversely cognition is itself determined by action. Nor must we forget that the primary motive of action is the attainment of pleasure and the avoidance of pain. I say the primary aim and the primary motive; for with physical and intellectual development there are brought into play new principles, namely, the postponement or even suppression of action, the striving after pleasures that are remote and must be reached indirectly, and sympathetic actions performed partly for the pleasure of others. The nature of canine cognitions must therefore be determined by the nature of the self-regarding or sympathetic pleasures sought (and pains to be avoided), and by the nature of the actions which are essential to the attainment of that pleasure or avoidance of that pain.

Unfortunately, however, this conclusion, whatever may be its theoretical value, is of very little service practically, from the difficulty of its application. We may say, indeed, that the pleasures aimed at by the dog are in the main personal,—that the object of their actions is for the most part self-gratification. But even here, in civilised dogs, if one may so call them, the peculiar influence of the companionship of men has wrought a great change; so that many actions are performed by the dog for his master's sake. Nothing, indeed can be more striking than the way in which some dogs seem able to sympathise with their master's moods; and the same is true of their actions towards their canine companions. No one who has had the opportunity of watching the habits of the dog can doubt that the more refined and delicately organised individuals feel keenly for the wounds or sickness of their companions. Dr. Andrew Wilson described, in the columns of "Nature," an habitual piece of unselfishnes on the part of a mongrel dog, "who for some years before the death of an old deaf and blind companion was accustomed to proceed to his resting-place, and bark in his ears, to warn him of the presence near at hand of the milk which the mistress of the house was accustomed to place for the delectation of both." And a friend of my own tells me of a dog who went to the kitchen and begged a chop-bone for "a miserable-looking white dog,"

a perfect stranger. "On looking out into the yard," writes my friend, "the memorable cur was seen enjoying the bone, Carlo sitting straight up watching him with a look of satisfaction." While we may say, therefore, that the pleasures aimed at are in the main personal, that the object of action is for the most part self-gratification, we cannot say that the pleasure is entirely personal or that self-gratification is the only object of action.

And with regard to the other point,—the postponement of action,—How far, it may be asked, has the dog the power of working now for a result in the future? This power, we must remember, is one of the main characteristics of civilised man. Man has the gift of self-restraint. A stimulus is received which prompts to immediate action, but the action is repressed or postponed. Present pain is cheerfully borne for the good results which are to follow. In savages and young children the power of restraint is not developed; they are impulsive. Immediate result is what they look to; to wait is misery. In the brute this power of waiting is still less developed, but it is not absent. A dog with a thorn in his foot will limp up to his master to have it extracted, though he knows that the process will be painful; he bears present pain for future ease. Mr. Romanes relates an anecdote which affords a good example of postponement of action. A black retriever was asleep, or apparently asleep, in the kitchen of a certain dignitary of the church. The cook, who had just trussed a turkey for roasting, was suddenly called away. During her temporary absence "the dog carried off the turkey to the garden, deposited it in a hollow tree, and at once returned to resume his place by the fire, where he pretended to be asleep as before." Unfortunately a perfidious gardener had watched him, and brought back the turkey, so that the retriever did not enjoy the feast he had reserved for a quiet and undisturbed moment.

A dog can also bide his time, and defer action to a more convenient season. And such postponement of action is a sign of developed intelligence; for it would seem to have been the original intention of Nature, so to speak, that stimulus should at once give rise to action. This is, in all probability, always the case with creatures low down in the scale of being; but as we rise in that scale, and as a central nervous system is more fully developed, a larger and larger tract of processes, accompanied by consciousness, separates stimulus from response. And now in man, and the animals which come nearest to man in intelligence, a great body of stimuli constantly received never pass into action at all.

With regard to these we remain in a state of passive receptivity. In such cases the nervous disturbance transmitted down the afferent nerve is not passed on to the efferent nerves, but is allowed to diffuse itself in the brain; and this diffusion of disturbance among nerve centres is, I believe, the most important physical accompaniment of consciousness.

We may say then, I think, in general, that the mental activity of the dog is chiefly, but by no means entirely, occupied in personal gratification, and that the personal gratification is chiefly, but by no means entirely, immediate.

One more question I would ask and briefly answer before I conclude. Has the dog any notions of right and wrong? Of course much depends upon the exact sense in which these words are used. But I think that we shall feel disposed to give a negative answer when we remember that to perceive that an action performed was wrong is by no means a simple process; for we have mentally to compare it with an action which might have been performed, and if so performed would have been right. And yet we so frequently hear it said of the dog that "he knows he's done wrong"! When, for example, my friend coming down into his drawing-room sees Tim's guilty look, he suspects that the dog has, contrary to rule, been taking a nap on one of the chairs; and his suspicions are not a little strengthened by the unnatural warmth of the easiest arm-chair. "Ah! Tim always knows when he has done wrong," says my friend. To be exact, however, the association in Tim's mind is in all probability a direct one between a nap on that chair and master's displeasure. What Tim knows is not that he *has* done wrong, which would involve more reflection than he is capable of, but that he *will* "catch it." It is the expectation of a reproof, or something more, that gives rise to the look of "conscious guilt." In the same way I believe the look of "conscious rectitude" we often see in some dogs is due to the anticipation of a word of commendation; and in general I fancy that the association in an animal's mind is between the performance of a given act and the occurrence of certain consequences. When this association becomes definite it must, I imagine, draw after it a dislike of such actions as have been accompanied by evil consequences, and a delight in those actions which have been accompanied by pleasant consequences; and eventually this dislike or delight is transferred from his own actions to the similar actions of others. Hence the cat punishes its kitten that steals; hence the baboon punishes another that performs an act which may

result in evil consequences. At the same time I believe that the love of a faithful dog for his master is such that to disobey him in itself gives rise to a sense of dissatisfaction which comes near to the prick of conscience, and that to please him in itself gives rise to a sense of pleasure which comes near to the approval of conscience.

Pleasure to be gained, pain to be avoided: these are the North and South Poles under the influence of which the compass of conscious life, brute and human, is set. In the lower animal life the pleasure is the pleasure of the senses or the gratification of appetite. These are the only things in which the animal is *interested;* they are therefore the only things of which he has any knowledge, the only things which can afford to him motives for action. The pleasure, moreover, is almost entirely individual; *each for himself against all* being the motto of the male, *each for herself and little ones against all* being the motto of the female. In the higher animal life sympathy begins to come in, and through sympathy a much higher type of action can be evolved, so that the motto becomes *each for himself and companions against all.* In the dog his affection for man raises him at once in the scale of being; many of his actions are performed not for self alone, but for the master. *Each for himself and for his master against all* is the motto of the dog. This is a great step, introducing many actions which are not merely done in self-gratification. Not his pleasure alone, but his pleasure in combination with that of his master has to be aimed at. When we come to man at his highest we have a quite new motto: *each with all for all.* Not his own pleasure alone, but the highest pleasure, and the greatest good of the community has to be aimed at. And much of the moral warfare of man may be symbolised by a struggle between the two mottoes—*each for himself against all,* and *each for all with all.*

The community of feeling expressed by the latter motto has, I believe, been made possible by language. Community of thought and experience has brought with it community of feeling; and out of this two-sided community has grown the possibility of those forms of pleasure which are essentially human. The pleasures of the senses and of the gratification of appetite have been supplemented by far higher pleasures,—æsthetic, intellectual, and moral. Interests, sympathies, knowledge have alike been widened. The difference between the human mind at its highest and the brute mind at its highest has thus been rendered immense. Very great, too, is the difference between the human mind

at its lowest and the brute mind at its highest; and one of the most marked ways in which this difference shows itself is in the fact that through the possession of language the lower human minds can be raised. The possession of language gives to the savage a potentiality of higher things altogether beyond the reach of the brute. The question whether animal intelligence could develop into human intelligence—or rather *has* developed into human intelligence—depends therefore very largely on whether language could be, or rather has been, naturally developed. This question I am not competent to discuss; but the principles of the great hypothesis of Evolution, which account for so many of the problems of Nature, lead me to think that most probably it has been so developed.

C. Lloyd Morgan.

III. THE SUN-SPOTS AND THE ZODIACAL LIGHT.

By A. H. Swinton.

THE astronomer Cassini put on record, about the year 1683, that during the prevalence of the sun-spots the zodiacal light may be expected during the months of February and October. This spring, when turning over the leaves of the "English Mechanic," I observed a note to the effect that an enthusiastic astronomer, whose eyes had grown dim in watching, had at length noticed this singular phenomenon. At that time, as far as my recollection goes, it took the form of a pale bluish halo in the transparent air after sundown; but it would appear as if the polarisation of the mellow autumnal mists have lent to it a far greater magnificence in some parts of the world. Under date of October 26th a relative writes from the Kangra Valley, North India: —"There has been a good deal of fresh snow on the hills; it has fallen early, and there is prospect they say of a cold winter. The last two nights we have seen the curious glow—you may have read of it in the papers—in the western

sky, long after sunset. It is something like an aurora, but does not flash, and is more lurid."

The zodiacal light, however, is not only seen at sunset, for it is frequently in the East the herald of sunrise. Dr. Adam, as quoted in the "Edinburgh Cabinet Library" (vol. iii., pp. 257-8), thus describes its shadowy form:—"It was quite dark, excepting what light the stars afforded, which in India is always considerable at this season (October), when not a cloud obscures the expanded vault of the heavens. After moving on for some time, on turning my eye towards the east, I could perceive the first appearance of day. It was not dawn, but a mere greyish pillar of light shooting from the horizon upwards, in the shape of a comet's tail, but without lustre; the effulgence, if it could be so called, resembling that of the milky way more than any other object in Nature which I have seen. This dull *pillar of light* was well defined. It continued a long time apparently little increased in size, and without having acquired much brilliancy. At length its sides near the bottom gave way, and the light, now stronger, diffused itself latterly to a considerable extent." Then came the roseate hue on the clouds, a pillar of red or orange-red light, and the large and fiery sun, the nucleus of the great comet and torch of day. The writer adds—"This pillar of light is the *zodiacal light* first mentioned in modern times by Childraus in the year 1559, and again seen by Cassini on the 18th March, 1683. Cassini, Mairan, Euler, Laplace, Regnier, Hube, and Hahn have speculated with regard to its nature." So also have Kepler, Fatio Duillier, and others more recently.

Perhaps the following extract that lately appeared in the "Daily News" may tend to show that the zodiacal light is a beam of *light* proceeding from the sun, or rather the lenticular form the light given out by the sun assumes when seen through our concave atmosphere under certain conditions of dryness or humidity. "Mr. M. L. Rouse, of the Inner Temple, writes to us:—'In coming up from Maidstone to London by the Chatham and Dover Railway, on Thursday, the 9th of November, our train was nearing Sevenoaks at half-past five, when we perceived in the north-west above a black band of cloud that lay along the Knockholt Hills a bright semicircular flush of pink light, which kept its colour undimmed for fully a quarter of an hour, amid the deep azure of the surrounding heavens, spangled with stars almost to its very border. Towards its centre the pink, or red, was shaded off to yellow, and a yellow riband of light

was seen through a rift in the dark band aforesaid. A little further on the road we found that it had grown paler, the yellow tint replacing the red. The centre of this rosy film was about 50 degrees north of the point of sunset, and it spread in length over some 30 degrees, and in height above the cloud-bank 12.'" Doubts were cast upon this beautiful sight being an Aurora Borealis, and the writer would suggest that it was a form of the zodiacal light produced by atmospheric *refraction*. The fine lunar rainbows that have appeared during the past damp spring may have been remarked; one was seen near Glasgow, at moonrise, on the 24th of February, that stretched from the eastern to the western horizon; and a beautiful one was seen at about half-past eight on the 16th of April at this place, encircling the moon: the sunset had previously been remarkable, for no sooner was the luminary descended than a sheaf of rosy rays shot up like a bouquet of sky-rockets.

Guildford, November 20, 1883.

IV. BARON NORDENSKJŒLD'S GREENLAND EXPEDITION.*

By Count O. Reichenbach.

BARON NORDENSKJŒLD draws from his experiences some conclusions by which he renounces without necessity with the mistaken also the correct in his former expectations. My anticipations having proved right with regard to the leading questions, I beg him to reconsider his present views. I do this not from fondness for contradicting, but in the interest of a theory of the configuration of the Earth mostly contained in "On some Properties of the Earth" (London, 1880), where the passages quoted may be found on the pages here named.

The Baron said in his programme, "On the contrary, the following reflections seem to demonstrate that it is a physical impossibility that the whole of the interior of this extensive

* "Nature" of May 10th, and 1st and 8th November, 1883.

continent can be covered with ice under the climatic conditions which exist on the globe south of the 80th degree of latitude." "With regard to Greenland it is not difficult to demonstrate that the above-described conditions for the formation of glaciers do not exist," "if the country does not rise gradually both from the eastern and the western shore to the centre, and thus be like a loaf of bread in shape, and with sides slowly and symmetrically terminating in the ocean. Such a land formation is, however, not found in any part of the orography of the known world, and one may therefore safely conclude that neither is it to be found in Greenland. In fact the geological nature of Greenland, very similar to that of Scandinavia, seems to indicate a similar geographical formation, *viz.*, a formation formed of mountainous ridges alternating with deep valleys and plains; while one may even assume that the culminating line of the land in Greenland runs, as in England and Sweden, and in both American continents, along the west coast."

Having found the interior of Greenland covered with ice, Baron Nordenskjœld says—"That we found no ice-free land in the interior, or that it does not exist between 68° and 69° latitude, is due directly to the orographical conditions which exist in this part of the country, as referred to in my programme of the expedition. The *land has here* the form of a round loaf of bread, with sides gradually and symmetrically sloping down to the sea, *i.e.*, exactly the shape which I then pointed out was a necessary condition if the entire country should be covered with a continuous sheet of ice."

Page 277 I said—"The great mass of all perennial ice has grown on land. Huge glaciers, wedged between mountains and vast ice-fields of great thickness, cover the polar lands, whereas ice formed on the ocean never exceeds 33 feet." "These masses of glacier and field ice travel from higher to lower ground, and under thronging pressure over dale and hill until they fall as frozen rivers over precipitous cliffs into the sea, or enter it gliding from gentle slopes, get beyond their depth, are uplifted, split under contending pressures and temperatures, and drift as hard land ice amongst the softer ocean ice to be gradually consumed."

"For the formation of ice-fields it is only required that more water from the atmosphere should be deposited on land, at a temperature below 0° on a surface below 0° during part of the year, than the direct rays of the sun and the indirect sources of the heat can melt during the other part. When there is a considerable excess of ice formed over the

surface, a portion may move to places where there is an excess of heat, but not sufficient to consume the imported ice, which becomes perennial."

"The growth of perennial ice within the *Arctic zone*" "is almost entirely confined to the *polar land section*, Greenland, the Archipelago, and scattered islands." I distinguish between astronomical and meteorological zones; the lands belonging to the continents Asia, Europe, and America inside the polar circle are not strictly polar, whereas lands outside that circle belong to the *polar section*. "Many icebergs are destroyed within the Arctic lake and its outlets; others enter the Atlantic, and melt about the bank of Newfoundland, and between 44° and 52° W. long., &c."

"We may assume that in Greenland," "and in the more extensive islands," "the east coasts are more precipitous, with little extension up to their crests. We may infer, chiefly with regard to Greenland, that the western shore, less elevated and comparatively free from ice, sufficiently rises inland to give to the interior and its ice-fields between east and west the shape of a trough. We may consider it likely that in the north-east of Greenland, to the west of the peninsula or island chain (Part I.), reaching almost to 87° N. lat., there is about 82° 20′ lat. the mouth of a comparatively considerable river, occupying a position *similar to the Nile* in Africa, &c."

Page 278: "As the west coasts of Greenland and the islands are most free from land ice, the excess in the deposition of water must fall on the *east* and the *interior*. It must come with the reflux of the polar atmosphere, by aspiration, after the warm ocean stream has been reversed at the North of Europe and Asia, and the atmospheric currents have been partly reversed, from east to west, from the west coasts of Nova Zemlya and the west coasts of the spurs of the Ural and the Siberian peninsula, and have partly sped on overland, north to south, through Siberia and North America."

I also pointed out similarities of the *Arctic section*, Greenland, and the Archipelago at its west, with the sub-section of the "middle segment," Scandinavia with Finland at its east, but remarked that they are inverse in position as to west and east, the elevated borders in Greenland being placed inversely as the "Appalachians and Cordillera," the greater elevation facing the greater ocean, according to Dana's rule.

When Baron Nordenskjœld cautiously says "The country, or *more correctly the ice*, now gradually rose from 963 to

1213 metres," I, assuming that the eastern rim is highest, as those who navigated in the east confirm, and together with the western rim gives to the "interior and its ice-fields between east and west the shape of a trough," naturally meant that *the land* has the shape of a trough filled with frozen water.

Baron Nordenskjœld supposes "a formation" "not found" "in any part of the known world," merely because he believes one cannot otherwise account for the ice in the interior, being himself not aware to what extent the atmospheric and oceanic circulation, and the *sectional* character of the polar regions, differ from that of other regions.

Pages 277 to 294: I find that all perennial land ice to a great extent afloat on the sea represents a block 1018 feet thick, covering 773,000 square miles (60 sea miles to a degree) divided between north and south in proportion 1 : 4·78; but that, being in every state of growth and decay, it occupies 2,236,000 sea square miles, equal to the Arctic and Antarctic *land sections*, themselves only covered to 2·07÷3·08 of their extent by perennial ice, the remainder being on sea and 1÷20 on other lands; and that the thickness of this ice varies from incipient growth and ending decay to that of a ripe berg about 3040 feet, going out to sea.

Can such masses extending over the whole width of Greenland, having "here" the shape of a round loaf of bread, descending symmetrically with uniform declivity to the sea, unresisted by guiding embankments of solid rock, present the spectacle described? Could there exist such an unbroken smooth surface as the Lapps passed over in so short a time? Would not the whole mass, furrowed during the warm season by water above and below, expanding, splitting, move down to the ocean with increasing rapidity, leaving the incline denuded for a new gradual growth of ice?

The harbour where the Expedition landed was "surrounded by gneiss rocks from 600 to 1000 feet in height," 1018 feet being the mean elevation of all land. The first camp on the ice was 240 metres above the sea. From camp 9, at an altitude of 753 m., "on the west side of an ice-ridge, where water from a small shallow lake collected into a big river disappeared in an abyss with azure-coloured sides," the travellers had their parting look at the country to the west, and saw even the sea shining "between the lofty peaks on the coast." Does this not mean "a mountainous ridge" at the west, between camp 9 east of the fjord entering far inland and the coast line?

The drawing in "Nature" very indistinctly shows the

direction of the watercourses, springing not from land, but from melting ice, and moving in beds of ice; they seem to point south-west and north-west as if divided by a crest indicating an elevation west to east below the ice. I pointed out similarities in the outlines of the Arctic section with Africa, Greenland corresponding to Africa east of 9° W. long. Gr., and the Archipelago to Africa west of it, and the elevation might be compared to equatorial Africa.

I was and am still of opinion that southern is higher than northern Greenland; that the elevations west and east decline going north, the eastern again rising as a peninsula or island chain between 85° and 87° N. lat.; that the ice slowly travels north; that the depressions west and east inside the bordering mountains, having an elevated plateau between them, unite in the east going north, determining and following a river bed I compared to the Nile, whereas the north-west becomes a plateau widening and descending towards the north.

The ice-field at the south, occasionally eased by glacier arms over watercourses through rents of the mountain-borders in west and east, slowly proceeds north-east through the wide valley of the polar Nile, which has its dry seasons and its inundations of icebergs and lifting pushing water, the bergs moving at its mouth west of the north-eastern *peninsula* out to sea, where they are first driven north, then west, and drift decaying through the different channels of the Archipelago towards and into the Atlantic. I believe in the open sea of Dr. Kane, and in the same sea covered with old and new drift-ice as seen by the party sent out by Capt. Nares, because I believe in a periodicity and oscillation of the ice motion and drift in the Arctic as well as in the Antarctic regions (pp. 279 and 281).

As equatorial Africa has its dry and wet seasons, and the Nile its low and high water, so has Greenland its great deposition of moisture at the south and its periodic ice motion in the north-east along the eastern river-bed and depression. And as south-western Greenland outside the western mountain-range has its moist climate and its pastures, so has the north-western plateau, like that neighbouring the Nile at its west, a comparative dryness which keeps it freer from the formation of perennial ice and a scanty vegetation,—as confirmed by Dr. Kane's and Capt. Nares's experiences (p. 127), who even speak of musk oxen near their winter-quarters.

We may then assume that the bones of reindeer seen by Baron Nordenskjœld were those of stragglers from "herds"

which travelled in search of food from the north-west, over the wide high intervening ice-fields inside the western range towards the settlements and pastures in the south-west; and we may understand why "water fowl" came from the north, and the two far-exerting ravens, who, after this visit to the travellers, again returned north.

According to my theory the growth of perennial ice within the interior is greater east than west, the deposition of ice being less and the melting greater in the west. This view I find supported by the grouping of the distances travelled with the ascents, which are not only due to the elevation of the land below, but to the unknown thickness of the ice increasing towards the east.

Leaves and berries from the south-western coast were found west, but not east, of camp 9, on the snow; they had been driven before the *ascending* wind to this weather-line, east of which the fine time turned to rain, sleet, and snow.

The most rapid ascent, 19 m. to each of 5 kilos., was from camps 8 to 9, where, at an altitude of 753 m. west of an ice-ridge, the travellers saw the last of land and the sea shining through the "lofty peaks" on the coast. The ascents now varied from 9·5 m. to each of 13 kilos., to 0·7 m. for each of 10 kilos., probably a real fall of the land; and rose again to 5·05 m. to each of 17 kilos., and to 7·87 m. to each of 31·5 kilos. The altitude being now 1213 m., the ascent to 1492 m. then fell to 4·8 m. for each of 58·5 kilos., and the ascent to 1975 m., reached by the Lapps even to 3·75 m. for each of the further 122·5 kilos.

Assuming that at the altitude of the 1213 m. the thickness of the ice was 200 m., and at that of 1575 m.—where all rivulets to south-west and north-west ceased, and the waterless smooth ascent commenced—the thickness of the ice amounted to almost 1000 metres of ripe bergs, the altitude of the land at the 1200 m. would still have been 400 m. more than at the 1600 m., and the 400 m. farther ascent on the smooth ice might signify a high plateau between depressions west and east, directed south to north, and uniting farther north-east to the bed of the polar Nile.

The ascent could not be detected by the eye "on that ice horizon which was everywhere as level as that of the sea," or by the greater exertion in ascending, "so that it was impossible to decide whether we walked up or down hill, and this formed a constant source of discussion between us, which could only be decided by the heaviness of the sledges in the harness,"—a very unsafe standard, because depending on the smoothness of the surface and the fatigue of the parties.

The guarantee for the altitudes is, then, the barometer alone, and the following sentence is perhaps worth considering, because not written on purely theoretical grounds:—Already in 1880 (p. 292) "great deposition of perennial ice on land increases the temperature of neighbouring vapour to be absorbed by the sea, and favours the absorption of the heavy gases; it *lowers barometric pressure.*" If this be right the altitudes would be liable to being overrated increasingly, proceeding inland on polar ice increasing in thickness; principally in certain seasons and in comparison with barometric pressure or the neighbouring polar sea, where the pressure is relatively increased by absorption of vapour, the whole relation in these regions being thus to a certain degree out of comparison with the similar relation in other regions where experience was acquired.

V. THE POTASSIUM NITRITE OUTCRY.

IN days of old scientific discoverers often found it needful, or at least prudent, to record their observations and conclusions in language not too readily intelligible to the outside world. Sometimes a fact was veiled in the form of an anagram. Sometimes a theory was presented as if in joke, or was followed up by a sham refutation, so that it became difficult to prove what were the real opinions of the author. The reason why truth, or endeavours after truth, had to be thus carefully veiled was, as most of our readers are aware, the jealousy of the Church. But what few of us duly consider is that—as far as one of the most important of the Sciences is concerned—we are fast drifting into a position which will render similar precautions necessary in our *quasi*-enlightened times. Just as a couple of centuries ago there were men who studied the transactions of academies and the writings of individual *savants* merely in the hope of detecting some new heresy, so at the present day the New Inquisition is unceasingly at work. Its familiars carefully examine all physiological, and especially all medical, works and journals,—not for instruction, not for criticism, but in the hope of finding something which, by the

aid of a little judicious distortion and misunderstanding, may be construed as cruelty. An eminent medical contemporary says :—" So long as lay readers indulge that morbid curiosity which leads them to peruse the pages of medical journals, it is certain that scares innumerable will be created." With all due deference we would suggest that the motive for such perusal is stronger than mere morbid curiosity. The paid official, if seized with a fit of truthfulness, might exclaim—" Sirs, ye know that by this craft we have our wealth ! " The honorary official, if candid enough, might admit that his esoteric motive is *kudos*, self-advertisement, and, in an indirect manner, advantages of a more tangible nature. Small likelihood, therefore, that such persons will desist from their search for something about which an outcry may be raised and the public deluded. Such are the tactics of all agitators, the " Humanaster " not excluded. The case then stands as follows :—In place of the Holy Office we have certain self-constituted societies ; in lieu of " Domini Canes " and the other mendicant orders we have a crowd of novelists of both sexes, who certainly have not taken the monastic vows. Lastly, certain ethicist writers undertake the task of a Caccini or a Scioppius. By the machinations of these men and women, peers, prelates, judges, and Royalty itself, have been deluded into a league against Science.

These reflections are naturally suggested by certain recent doings and sayings. Drs. Ringer and Murrell, it appears, have tried the effects of sodium nitrite in the treatment of some diseases, and have communicated the results—unsatisfactory, if not alarming—to the world in the columns of the " Lancet." What were their motives for administering this salt we—not being a medical practitioner—cannot profess to explain ; but in ordinary candour we feel bound to assume that their previous experiments upon cats must have given them reason to expect that in certain cases it might prove of value.

Their conduct in making and publishing these experiments has been severely criticised by the " Medical Times " as " a deplorably false move, which the ever-watchful opponents of vivisection will not be slow to profit by."

It has been very justly contended that one of the results of the " Vivisection Act " will be to render experimentation upon human beings more frequent ; but in this case no such plea can be admitted, since two cats had been previously experimented upon, and that with rapidly fatal effects. The " Medical Times," indeed, holds that it is impossible to

acquit Drs. Ringer and Murrell of grave indiscretion: On the principle of the trapper who seeks to secure himself against a prairie-fire by raising a back fire, it adds :—" It is with the view, if possible, of forestalling the outcry of the Anti-Vivisectionists and counteracting the effects of this terribly false step, that we have felt ourselves compelled reluctantly to enter this protest against it."

The " Medical Press and Circular" takes a more dispassionate and judicial view. It holds that "to educated medical men there can be no question either of the value of the observations detailed or of the *bona fides* of the intention with which they were carried out." It adds that " the aim of the authors was to extend the limits of our therapeutic resources by laying before the profession an account of the action exerted upon the human system by a certain drug, and every addition to the agents with which the physician is enabled to combat disease is so far a distinct gain to humanity that the most complete reports in this regard are in the highest degree valuable and acceptable." It adds, very justly, " If it should chance that we have in it a means of combatting certain affections with success, then to omit the measures necessary for proving in what manner and proportions it requires to be administered would be to criminally neglect the imperative duty of Medicine towards humanity. Until Nature's fertile resources against illness are completely explored, and each secret she can yield to therapeutics is laid bare to the hands of every practitioner, the search after new remedies must perforce be continued if we would not be diverted from the path of conquest over sickness."

Unfortunately the discussion has not been confined to professional organs. A Mr. Ernest Bell, M.A., writes to the " Standard " on the question, making large quotations from the original paper of Drs. Ringer and Murrell, bringing grave charges against hospital physicians, and displaying—if we misunderstand him not—an intense hostility against the organic sciences. Who this Mr. Bell, M.A., may be we are utterly ignorant. We do not know that he is a member of any of the Bestiarian societies ; but he sufficiently characterises himself when he speaks of a " mania for testing everything and anything on all sorts of animals." Without we test " everything and anything " we must remain in ignorance about animals no less than about plants or inorganic matter. To this " mania " we owe our physics and our chemistry. If animals are to be exempted from research, the organic sciences, with their practical applications, can never be fully constituted.

It is sickening to see Bestiarians ready and willing to inflict inconvenience, pain, or death on "all sorts of animals" for any purpose save the acquirement of knowledge. May we not legitimately infer that a love for ignorance is with them more powerful than the reluctance to give pain to sentient beings?

As regards Mr. Bell's insinuation that hospital physicians intentionally abuse the opportunities of their position to make experimental studies upon their patients, we regard it as utterly unfounded, and we think it deplorable that any person with the slightest pretensions to culture should entertain, and what is worse, should seek to promulgate, so baseless a notion. We are glad to find that the "Standard," whilst considering Drs. Ringer and Murrell open to the charge of indiscretion, is yet very far from endorsing the charges brought by its correspondent. This is merely what might have been expected from its honourable antecedents. Every scientific man must remember that its conduct anent the Bestiarian hubbub has formed a refreshing contrast to the position taken by two of its daily, and still more by one of its weekly, contemporaries.

VI. ON THE HYBRIDISATION OF AMPHIBIANS AND THE PRINCIPLES OF REPRODUCTION.

AN extended series of experiments on the hybridisation of certain varieties and species of frogs and toads has been conducted by Professor E. Pflüger. The results, which have just been made public, are of the highest scientific importance, and merit the careful attention of naturalists.

The author establishes, in the first place, that those differences which determine the character of a race by no means compromise fertility. As regards the species experimented upon it appears that the large Berlin lake-frog and the blue frogs of the Rhine are not species, but merely varieties of *Rana esculenta*. On the other hand, *R. arvalis* (s. *oxyrhinus*) is not a variety of *R. fusca*, the brown grass-frog, but a distinct species.

As regards hybridisation the results obtained may be laid down in the following proportions :—

1. Pflüger and W. J. Smith have obtained three living frogs sprung on the mother's side from *R. arvalis*, the father being *R. fusca*. Herr Born has been much more widely successful in this respect, and has obtained many such specimens.
2. Perfectly vital semen and perfectly vital ova, capable of giving rise to perfect normal ova, possess only for a brief time the power of producing hybrids. This stage is that of the most intense heat. After it is past the ova still react normally with the semen of their own species. This fact demonstrates that the unfecundated germ and the sperm-cells before fecundation are subject to continuous internal change.

This rule holds good most sharply and distinctly for the ova, whilst the sperm is still capable of effecting a hybridised fecundation for some time before and after the most intense stage of heat.

3. Herr Pflüger succeeds in demonstrating that hybrid fecundation can be perfectly reciprocal. The sperm of *R. esculenta* fecundates the ova of *R. arvalis* as energetically as the sperm of *R. arvalis* fertilises the ova of *R. esculenta*.
4. More generally, however, hybridisation is one-sided. The sperm of *R. fusca* fecundates energetically the ova of *R. esculenta*, but the sperm of the latter has no action upon the ova of the former. The sperm of *R. fusca* does not fecundate the ova of the *Triton* (newt), whilst the sperm of the latter fertilises the ova of *R. fusca*.

This one-sidedness, if we may so call it, Prof. Pflüger explains by means of the following facts :—

a. Those spermatozoa are most capable of effecting hybrid fecundation which have their anterior part thin and pointed.
b. The ova of species whose spermatozoa have a thick anterior extremity are most liable to hybrid fecundation.

We have thus a simple mechanical explanation of the one-sidedness of hybridisation, the micropyle being exactly wide enough to allow the spermatozoa of the same species to penetrate into the interior of the ovum.

The following actual observations agree readily with the above hypothesis;—The spermatozoa of *R. fusca* have, among all Amphibians, the thinnest anterior extremity, which terminates in a sharp point; in consequence they fecundate almost all ova upon which they are allowed to act, such as *R. arvalis*, *R. esculenta*, and *Bufo communis*. On the other hand, the thick-headed, blunt-pointed spermatozoa of *R. arvalis* and *R. esculenta* cannot penetrate into the ovum of *R. fusca*. The spermatozoon of *Bufo communis*, which has a thick head but a very sharp point, in some rare cases fecundates the ova of *R. fusca*. The spermatozoa of the tritons, having pointed heads, can also fertilise the ova of *R. fusca*. On the other hand, the thick-headed and blunt spermatozoa of *R. arvalis* and *R. esculenta* cannot fecundate any strange ovum, whilst reciprocal hybridisation between the two species is easy.

In like harmony with the hypothesis the ova of *R. esculenta* are in the highest degree susceptible to the action of alien spermatozoa. They can be fecundated not alone by the male element of the frogs *R. fusca* and *R. arvalis*, but by that of the toads *Bufo vulgaris* and *B. variabilis*, and even *B. calamita*. The sperm of the tree frog (*Hyla arborea*) was found also not quite inefficient.

So far, indeed, no Batrachian has been observed whose spermatozoa are less and whose ova are more adapted to hybridisation than those of *R. esculenta*.

The same is the case with *R. arvalis*, also in accordance with the same hypothesis.

Herr Pflüger points out, however, that the experiments on hybridisation instituted by M. de l'Isle, with *R. fusca* and *R. agilis*, whose spermatozoa are exactly similar in shape, gave negative results, so that here other cases must come into play.

The author's experiments with toads agree also with the same hypothesis. Thus *Bufo vulgaris*, whose spermatozoa are capable of acting upon the ova of *R. fusca*, is able to fecundate all ova which can be fertilised by *R. fusca*,—*i. e.*, *R. esculenta*, *R. avalis*, *Bufo variabilis*, and *B. calamita*. *B. variabilis*, whose spermatozoa fecundate the ova of *B. vulgaris*, should have spermatozoa of the same thickness, as is in fact the case. The same holds good for the ova of the same species; they are more susceptible to hybridisation than those of *R. fusca*, but less so than those of *R. esculenta* and *R arvalis*.

Hence it appears that an exact knowledge of the relative magnitudes of the spermatozoa of different species

is an urgent want which is not fully met by existing manuals.

In addition to the size, the shape and the penetrative power of the spermatozoa will have to be taken into consideration.

5. Hybrid fecundation leads in part to regular and in part to irregular segmentation. Very frequently there occur, in addition to the regular segmentations, irregular ones in larger or smaller numbers. According to the most recent observations we find regular segmentation in the crossing of very heterogeneous and very irregular ones, in case of nearly related species. Sometimes there appear in the same watch-glass, along with the most abnormal phenomena of segmentation which quickly lead to the destruction of the ova, perfectly normal ones, which even give rise to viable frogs. It is almost impossible to admit that among the spermatozoa of the same portion of sperm, and among the ova from the same ovary, so great varieties of constitution may exist as to explain these striking diversities. Some quite new and peculiar agency must come into play.

In order to find a key to this riddle Prof. Pflüger investigates the principles of generation as they appear from the researches of Pringsheim, Hertwig, Fol, Selenka, Schneider, Bütschli, Strassburger, Elfving, and others. From all these researches it may be deduced, as an established principle, that generation depends on the principle of the co-operation of two specific powers, the sperm-nucleus and the ovum-nucleus. From the observation of Fol, that sometimes several spermatozoa penetrate to one ovum, and that then there arises from such egg a polygastrula with several invaginations (and that several individuals may arise from ova thus fecundated), Pflüger concludes that each ovum which has hitherto been considered as a unity may give rise to several individuals, the egg, and homologically the spermatozoon, also corresponding to a plurality of individuals. The principle of dualism in generation is, however, still upheld by the view that the many germs act upon each other by twos, whilst the superfluous ones perish.

Prof. Pflüger cannot ascribe to morphological relations any part in generation. It is a physiological process depending on the specific interactions of atoms and molecules, and independent of any aggregate condition,—consequently not subject to any general morphological law. We shall

probably never find an anatomical definition for generation, as in principle none is possible.

If we consider that every point in our organism is influenced both by the spermatozoon and the ovum whence we have originated, it is plain that generation presupposes the absolute intermixture of the substance of the spermatozoon with that of the ovum. When, therefore, during the act of generation (which lasts until the two cells have become one,—*i.e.*, from the moment when the head of the spermatozoon comes in contact with the yolk to the origin of the first segmentation nucleus), the matter of the spermatozoon is molecularly mixed with that of the ovum, this can scarcely be understood save on the supposition that the generative elements are, at least at certain points of time, in a state of liquid aggregation. The true germs may easily be chemical molecules of definite constitution. The spermatozoon must evidently surrender its inherent organisation in order to become an integrating and all-present part of the new organism, and the same holds good for the ovum. Necessarily there exists a moment of internal transposition of the molecules, and doubtless in part of the atoms. During this stage of revolution there exists no organisation. Our readers may here be reminded of the suggestive fact that when the larvæ of certain Diptera pass into the state of pupæ their muscles are resolved into a uniform semi-fluid mass. During the act of generation, properly so called, we have neither cellular substance nor nucleus, but nascent protoplasm. That this view is correct in principle can scarcely be doubted, though these processes are probably not completed simultaneously in all points of the generative mixture.

The author sums up his views on this part of the subject in the following chemical, or perhaps metachemical, representation :—

The chemical work in the molecule of living animal matter possesses its highest intensity in youth, and then decreases, becoming very small in age, and being extinguished at death. The "active" molecules—those with free affinities—constantly decrease, whilst the closed molecules increase. Hence for the maintenance of life a reciprocal process must exist, for converting the closed molecules into open or active ones. The opening of the closed affinities of the germs is therefore the essence of generation.

As every chemical reaction of two molecules liberates chemical affinities, and as electricity, heat, and light do the

same, there is no difficulty in the thought that the needful opening may be effected by the action of the male germ upon the female. In order to open chemical affinities by chemical agency there are required at least two kinds of molecules, different in some respects. This is the signification of dualism in generation.

The muscle-, nerve-, and gland-molecules form their own likeness out of the nutriment. The living molecule or molecular group has the power of impressing itself upon dead molecular groups, and converting them into its own likeness whilst receiving them into its society,—*i.e.*, into the realm of the living.

Since according to this principle the male and the female germ act upon each other in generation, each will force its peculiarities upon the other. Since thus there arise two germs of approximately like nature, the question arises whether they remain two separate individuals after fecundation, since we assume the existence of many germs in the ovum and in the spermatozoon. If we admit for a moment the hypothesis of such distinctness, we can draw therefrom certain conclusions.

If we suppose that the germs derived from the spermatozoon retain, even after fecundation, a certain specific peculiarity as compared with the ovum germs, it follows that on the formation of the sexual organs in the embryo there may be evolved two kinds of germs,—derivatives of the spermatozoa and of the ova. Each organism would thus be primarily a hermaphrodite.

When both kinds of germs begin to increase they react upon the transformation of matter in the organism, and modify the composition of its fluids. It appears now that very frequently the modification of the organism determined by the vegetation of the sperm-cells interfere with the development of the ova, and conversely the growth of the ovum masses hinders the development of the sperm-cells. Thus the sex is determined according to the germs provided with the greatest vital energy. But as the male and female germs have on an average the same vital energy, males and females are produced in equal numbers.

If we assume many germs in the ovum and in the spermatozoon, the question arises what must happen if the number of each kind is unequal, and the excess consequently escapes fecundation. Such excess will generally or always perish.

So long as parthenogenesis is maintained by zoologists and botanists, and the possibility of its existence cannot be

disputed, it follows that the germs of mature ova may increase for successive generations without fecundation. The residual germs cannot therefore be at once set down as doomed to perish. These germs which escape fecundation would explain the " reversion " of hybrids, if indeed it exists in a pure state. But a pure reversion would be intelligible even without such superfluous germs, as in hybridisation fecundation often fails, so that in one and the same ovum, along with united germs, there may co-exist unpaired male and female germs.

As to the cause of the paradoxical behaviour of the eggs of *R. arvalis*, fecundated with the sperm of *R. fusca*, Prof. Pflüger refers this phenomenon to "fractionated fertilisation." According to the observations of M. Fol the spermatozoon is immediately attacked by the yolk of the ovum at the moment of contact; consequently also when only the point of the head touches the yolk, the thicker part being kept back by the narrowness of the micropyle, or by the excessive stiffness of the gelatinous matter.

We may thus imagine that the point of the head of a spermatozoon which has penetrated into the yolk, whilst the thicker portion is wedged fast, may be resolved into particles, thus producing an abnormal segmentation.

This explanation of anomalous hybrid segmentation by " fractionated fecundation " renders it intelligible why in hybrid fertilisation we can find no rules. Each egg becomes differently segmented, perhaps because the quantity of the spermatic substance differs in every case. Such anomalous segmentation is not inseparably connected with hybridism; it occurs also during the fecundation of the ova of *Bombinator igneus* with the normal sperm of its own species, if too little water is present. The gelatinous mass enveloping the ovum remains then very stiff, and it is possible that the spermatozoa may often fail to penetrate into the yolk. If the fact that the hybridisation of nearly related Batrachian forms leads sometimes to normal and at other times to the most abnormal developments may be explained as above, it is very probable that both irregular segmentation and entirely negative results in crossing the Anoura are due merely to such secondary complications. The true law is probably reciprocal fertility in all with normal segmentation, and, with few exceptions, death during the first stages of development. Whether this law extends to the hybridisation of the Anoura and the Urodela cannot be asserted.—*Pflüger's Archiv. und Naturforscher.*

VII. DR. MELDON'S ELECTRIC MOTOR.

ELECTRICITY, both as a means of lighting and locomotion, has made, during the past few years, such vast strides in public favour, that it is not surprising many discussions have been raised concerning it, or that the minds of the leading scientists have lately become engrossed with the study of so interesting a subject. Up to the present, however, owing to the enormous amount of electricity required to work even a medium-sized dynamo, all attempts at electric propulsion, especially as regards boats, may be considered as purely experimental, its most ardent advocates being unable to claim for it any economical advantage over steam. Many theories have been adduced towards, and several electricians have applied themselves to the task of, surmounting this difficulty; but it is to the intelligence and ingenuity of an eminent Irish physician that the scientific world is now indebted for the discovery of an important principle, which will, without doubt, be recognised in future in the construction of all magneto-electric machines. To Dr. Austin Meldon, of 15, Merrion Square, Dublin, belongs the credit of having designed a motor which not only does away with the manifold disadvantages and drawbacks attendant on the employment of dynamos, but also creates the largest amount of driving power, with the least expenditure of electrical force. Dr. Meldon, in his first attempt at motor construction, made use of twelve magnets, but when the machine was tested it was found that although each of the magnets would lift half a cwt., or attract a heavy iron bar from one inch, yet the whole twelve, when bound together, would only lift or attract exactly the same weight. Seeing that something was evidently wrong he sought information as to the cause of so singular a circumstance, but although he received a very large number of suggestions, not one of his correspondents hit upon a solution. Nothing discouraged, Dr. Meldon persevered in his investigation, with the gratifying result that after some trouble he found that the inertness of the magnets was due to neutralisation, and that by magnetically insulating the bars—about to be described—with copper instead of iron bolts, and putting a few layers of gutta percha between the bars and the rims of the wheels, he could develop full power,—a fact which seems to have been hitherto unknown.

The armature of the new machine is formed by joining together two 15-inch solid pulley wheels, with seven flat bars of iron, each bar being 24 inches long by 3 inches wide, and $1\frac{1}{2}$ inches thick, and, as has been observed, the bars are laid upon gutta percha, copper bolts being used to fasten them to the wheels. A shaft of $1\frac{1}{2}$-inch steel passes through the centre, and the whole is supported by a hard-wood frame, stayed with iron. Each side of the frame, where the shaft emerges therefrom, is supplied with an ivory commutator, the one on the right having three, and the other four, brushes, each of which communicates with a magnet. Attached to the frame are seven electro-magnets; the three larger ones being made of 2-inch soft iron, and wound with No. 14 wire, without bobbins, and the other four of $1\frac{1}{2}$ inch iron, and wound with No. 11 wire. The total weight, as at present constructed, is a little over 3 cwts. The first trial of the motor took place in July last, in a boat 22 feet long and 5 feet beam; and the battery used on the occasion consisted of thirty-six cells of bichromate of calcium, with zincs 6 by 4 inches, and carbons 6 by 5 inches, the latter, as will be observed, *being larger than the former.* Half of the cells passed through a commutator into one set of magnets (the whole charge going into one magnet at a time), and the remainder of the cells, through the other commutator, into the second set. The great utility of this arrangement was experienced during the trip, as when all the cells were made use of the boat went at full speed, but when only one commutator was employed half-speed was obtained, and on a long trip the second battery could, of course, be re-charged. The motor is capable of making about 900 revolutions a minute, but this in the trial trip was reduced to 400, when the boat went over, with a slack tide, 9 miles in a little more than one hour, a single mile having been accomplished in seven minutes, and subsequently, when the tide was more favourable, 11 miles were gone over in an hour. A little over two-horse power has been registered from only twenty-four cells; and here it may be remarked that Dr. Meldon, who takes an unusual interest in anything that relates to this science, has managed, by a very simple contrivance, to get over the difficulty hitherto experienced in keeping up a continuous light for many hours: that gentleman has had five Swan lamps in his house during the past two winters, and he makes his bichromate cells last twelve hours, by using large zincs and carbons, which at first are only immersed a short distance in the fluid, and then after two hours lowered a few inches

more, and so on, using of course a larger number of cells than is absolutely required.

It is to be regretted that, owing to the small size of the launch, the battery, which was placed in the forward portion of the boat, eighteen cells being arranged on each side, occupied so much space that there was only room left for four persons to sit with any degree of comfort, and consequently he was obliged to abandon the idea of working his motor with a battery, but, judging by the actual results obtained, he is confident that with *two* storage cells of an accumulator he could easily obtain a speed of over 11 miles an hour.

The advantages claimed for the motor over a dynamo are—1st. Only one-tenth of the battery-power is required to obtain a single horse-power. 2nd. As there is no dead centre it will start instantly, and there is therefore no loss of power. 3rd. The whole force of the battery passes into one magnet at a time, so that very little power is required. It should be remembered that the launch *Electricity* had forty-five accumulators of the latest type on board, which were calculated to supply power for six hours at the rate of four horse-power, the mean speed obtained having been 9 miles an hour. Dr. Meldon's had only thirty-six cells, and did a mile in seven minutes, and it should be noted that the battery was nearly exhausted when this trial took place.

Dr. Meldon's object in consenting to the publication of these details of his motor is twofold:—First, to place upon record an account of his original experiments for the benefit of those who are interested in the subject of electricity as a motive power; and secondly, to receive any practical suggestions which the readers of this brief description of his important invention may be disposed to send to him. The magnets were supplied by Mr. Henshaw, of Christchurch Place, Dublin; the ironwork by Messrs. Booth Brothers, of Stephen Street; and the commutators by Messrs. Curtis and Son, of Abbey Street, same city.

ANALYSES OF BOOKS.

Evolution and Natural Theology. By W. F. Kirby, of the British Museum. London: W. Swan Sonnenschein and Co.

It is rarely possible for the scientific reviewer to take up a treatise dealing in any way with Evolution without a sigh of dissatisfaction. Too many such books are written by men profoundly ignorant of biology in every department, their sole preparation being, perhaps, the hasty and heedless perusal of a part of the "Origin of Species."

The work before us, we are happy to say, is one of a very different stamp. The author is well known as an industrious and successful worker in Natural History, thoroughly versed in the evidences, the bearings, and the results of the Doctrine of Organic Development. That, like almost every competent enquirer who has given the subject a fair study, he is a decided Evolutionist need not be said.

Mr. Kirby's object in the present book is to deal with one particular objection by which the religious world is still much exercised. Few of us have escaped being asked how we propose to reconcile the origin and career of plants and animals upon Darwinian—or more generally upon Evolutionist—principles, with the Mosaic cosmogony, as well as with many passages to be found elsewhere in the Jewish and Christian Scriptures? Such enquirers, if silenced for the moment, are by no means satisfied if we reply—in the language of Bruno and Galilei*—that the Scriptures were not intended to serve as a text-book of Natural Science, and that on such subjects they convey merely the ideas current in the days when they were written.

Such a work as that before us, in which the author seeks to show that the theory of Evolution is not "opposed to the principles of Christianity or the interests of true religion," will be welcome to many, and may, we hope, clear away prejudices which prevent many from giving the question a fair examination. Mr. Kirby, at the end of an opening chapter in which the ancient and modern views of Nature are contrasted, suggests that "Science and Religion may at length meet on the broad platform of Theism and Philanthropy." In this same chapter we meet with a passage not without significance as showing one remarkable tendency of modern thought:—"Nor can we for a

* See the letter of the latter to the Dowager Grand Duchess Cristina of Tuscany.

moment rationally suppose that even the highest and noblest of our race can reach the presence of the Infinite itself at one bound from a world so low as this. Rather let us acknowledge, with the Buddhists, the much greater probability that ages of progress, and possibly a great variety of stages of existence, may separate us from Nirvana."

Mr. Kirby, indeed, so far from being what is commonly styled a Materialist, makes a certain approximation to the so-called "Spiritualist" and Theosophic views. He contends for the immortality of animals as a corollary of that claimed for man, and on this subject he quotes Allan Kardec. In a note he speaks of the Resurrection of Christ as "a case of long-sustained materialisation." He accepts the doctrine of re-incarnation as at least conceivable, and combats some of the objections with which it is ordinarily encountered.

Hence the present volume will doubtless be read with interest not merely by avowed Spiritualists, but by that class—and judging from popular literature it is numerous—who have a vague yearning for evidences of an unseen world. On the other hand, this Eirenikon will fail to command the sympathies not merely of Materialists, but of orthodox religionists. We know that, in some quarters, to ascribe immortality to brutes is a deadlier sin than to deny it to man,

Turning from these generalities to a notice of particular passages, we find the author emphasizing rather more strongly than should we the modern origin and character of Physical Science. He urges that Evolution was not admitted in the days of antiquity, and judiciously remarks that "it would certainly not be a presumption in favour of Evolution that it was accepted as a truth by the ancients, but rather the contrary."

In discussing the old doctrine of Special Creation, he points out that the only view which can even partially reconcile such creation with existing facts is Gosse's theory of Prochronism, unmatched, and perhaps unmatchable, in its absurdity.

In the third chapter we find a statement which many of us will probably feel unable to accept. Says Mr. Kirby:—"The history of the earth, as a whole, furnishes no instance of a retrograde movement." Now even ignoring the Glacial epoch, a catastrophe some of whose results are probably irremediable, we can scarcely deny that a gradual refrigeration of the earth is going on, analogous to the senescence of the individual. Surely here is an element of retrogression, which, unless physicists are utterly mistaken, must sooner or later make itself felt.

On the subject of hybridism the author, as it appears to us, concedes too much to Anti-Evolutionists. He writes:—"Others supposed that new species might have been produced by the intercrossing of old ones: but this cause is now known to be physiologically almost impossible in a state of nature."

Again he says:—"The objection drawn from the physiolo-

gical difference between species and races still exists unrefuted." He adds, in comment, "This is indeed the great stumbling-block to all theories of Evolution." To us this objection seems merely an imperfect, and therefore false, generalisation." Mr. Seebohm, in his interesting work "Siberia in Asia" (*see* "Journal of Science," vol. v., p. 36), mentions the interbreeding of the carrion crow and the hoodie, which takes place on the large scale. The evidence of the fertility of these hybrids is quite conclusive. It is no less certain that the half-breeds between the American bison and the common cattle are prolific. These instances alone are sufficient to refute the objection cited.

In the chapter on Homology we find notice of one of the errors which on careful search may be found in the Duke of Aygyll's over-rated "Reign of Law." The Duke writes—"In his (man's) frame there is no aborted member. Every part is put to its highest use." Mr. Kirby, in reply, mentions the vermiform appendage in man, not only useless, but even dangerous.

Under the head Embryology we read—"We may hope that the actual length of human life will continue to increase until it ultimately reaches this limit (*i.e.*, 120 years)." So long as men and women are at a discount, as at present, increased longevity is anything but desirable, unless accompanied by other changes of which we see little immediate prospect.

In speaking of Geographical Distribution the author makes a remark which will be novel to many of his readers. He writes: —"The tropical representation of widely distributed genera are frequently inferior in size and beauty to those of temperate climates, and rarely surpass them, for the magnificent productions of the Tropics usually belong to groups entirely unrepresented in colder regions." It is noteworthy that specimens of *Chœrocampa Nerii* from South Africa are less beautiful than those from Europe, the green in the former being more of an olive cast. At the same time we must remember that such widespread groups as the Buprestidæ and Cetonidæ attain their greatest size and splendour in hot climates, those of Europe, North Asia, and North America being comparatively small and dull in coloration.

The author refers the fact that the African Negro does not, like the other inferior races, tend to die out in presence of Europeans, to climate. We doubt the sufficiency of this explanation, since the Negro multiplies rapidly in the healthy regions of South Africa and in many of the States of North America, where, indeed, the possibility of his ultimate preponderance is regarded not without apprehension.

We are heartily with Mr. Kirby when he protests against Mr. Galton's "ranking Socrates and Phidias above all who have suceeded them in Europe." Phidias we cannot profess to estimate, but the working and influence of Socrates and of his school were, we hold, decidedly pernicious. He blighted the

seeds which had been sown by Democritus, and led the way to that neglect and contempt of Nature from which we are only beginning to recover.

Were we, however, to notice every passage in this work which may be considered to deserve comment we should far exceed our allotted space; but we are bound to say that Mr. Kirby has presented the evidences of Evolution in a clear and acceptable form, showing that the New Natural History stands in no necessary connection with Atheism. Hence students of religious principles need not fear examining Nature from the point of view which Darwin and Wallace have made accessible.

To all the Invisible Gods: concerning two distinct Bibles being composed in the one Bible. Part First. From and written by JAMES W. FORREST, surnamed "JOHN." Comprising Special Revelations, and in reference to "Endymion." (No publisher's or printer's name.)

WE have here a work the greater part of which is devoted to scientific questions, but which is of a truly perplexing character. The author tells us in his Preface that to him there has fallen a strange, and in our age and life an unknown, position; that his writings form the only real Revelation published for eighteen hundred years. He comments on the "awe, fear, and dread which have been taught concerning the character of the true gods," and on the mystery of existence. He raises the old and painful question—"Why do not mankind find themselves in circumstances to satisfy their most natural desires and delights? What is, what was, the reason of restriction or 'holiness?'" Again, he asserts that he has received real Revelations, and adds that the consideration of these matters passes to him "from the deceased Earl of Beaconsfield, whose communications placed for my observation will be produced." Knowing that the deceased Conservative statesman was "for the angels," though too wise to commit himself to an indiscreet dabbling in Science,—as his great rival has done anent the evolution of the colour sense,—we have searched for these communications, but have not been able to find them in this "Part First."

Our author is prone to heresies, scientific as well as theological. On one and the same page he tells us that "animals were not born of the Father or formed by him, but were bred from the earth by certain changes which occurred some 6000 years ago or so." Here special creation and evolution are denied in the same breath, and a very recent origin is ascribed to the animal kingdom.

Theologians will stand aghast at finding in the next paragraph —and indeed throughout the book—Michael the Archangel identified with Satan.

Scientific dicta, or rather utterances on scientific topics, are numerous, but for the most part they are utterly contradictory to our present knowledge. Nor is there any evidence vouchsafed in proof of Mr. Forrest's conclusions. He writes:—" If anyone were to ask what nothing is, we might say that nitrogen is the nearest to it in existence. We should begin by defining its properties, or more exactly the properties it does not possess; it should have neither weight, hardness, taste, appearance, sound, smell, and no motion, therefore no colour or light, and be unclear, void. Nitrogen has no weight or action in the universe, being nothing." We need scarcely say that nitrogen has decidedly weight, and, though inert in the free state, is, when in combination, an essential constituent of foods, organic poisons, of the most beautiful colours, of many medicines and explosives.

Heat, we are told, " is a rubbing pressure, cold is a motionless pressure." Weight or gravitation is said to be " an improper state." Oxygen is pronounced a heavier body than other gases. We read further of " white motions, suns, or stars." Water is said to be " formed by a thin and invisible motion (such as hydrogen) moving in perfect space, grasping within its surface the still oxygen till it has assimilated or filled itself, and ceasing its own action, as also that of oxygen, both become water together which is clear like space."

We must confess that we are unable to reach the point of view needful for appreciating these propositions.

The writer concludes with a fascinating picture of "human life before time was."

Records of the Geological Survey of India. Vol. XVI., Part 2. 1882.

This part contains a Synopsis of the Fossil Vertebrates of India, by R. Lydekker. The oldest known amphibian, it appears, is represented merely by a skull and a part of a vertebral column of a large species from the Gondwanas. Curiously enough this specimen was sent to England for description eighteen years ago, and has only just been recovered, having lain all the time unnoticed.

Among the reptiles there is a notice of some vertebræ from the Panjab and Sind belonging to a python, and not to be distinguished from the living *P. molurus*.

Among the tortoises is mentioned the enormous *Colossochelys*

Atlas from the Sub-Himalaya and Burma. This fine species is supposed to have been 22 feet in length.

Mammalian remains are numerous and important, though none have yet been detached below the Eocene.

The Pliocene furnishes the palate of a female, and the upper canine of a male belonging apparently to a large anthropoid ape, *Palæopithecus Sivalensis.* This species is distinguished from the mias of Borneo and Sumatra, to which it otherwise approximates, by the narrower form of the premolars. *Felis cristata,* otherwise known as *F. palæotigris* and *F. grandicristata,* is a large tiger, distinguished by its greatly developed sagittal crest. To *Machairodus* (why, in accordance with all analogy, is this species not named *Machairodon ?*) belongs *M. Sivalensis,* ranging in size between the tiger and the jaguar.

All the known genera or sub-genera of the Proboscideans are represented.

The rhinoceroses—one-horned, two-horned, and hornless—are also well represented. Some remains, now in the author's hands, seem to approximate to the existing African species. The remains of rodents are few, and there is only one edentate, *Manis Sindiensis,* a pangolin four times the size of the still living *M. pentadactylus.*

Altogether a Pliocene fauna is characterised by the admixture of genera now peculiar to Africa, and of Miocene and Pliocene Europe with the forms now especially Asiatic. "Modern India has only the impoverished remains of a once extensive fauna of mighty forms." The high degree of specialisation of many of the genera is a marked feature.

The author adds, in conclusion, a very valuable chronological list of species.

Mr. F. R. Mallet, F.G.S., furnishes a paper on the "Iron Ores and Subsidiary Materials for the Manufacture of Iron in the Jabalpur District." The author recommends Murwara as a site for iron-works.

Mr. Mallet also contributes a paper on the "Lateritic and other Manganese Ores found at Gosulpur, in the Jubalpur District.

Mr. T. W. H. Hughes writes on the Umaria Coal-field, and recommends practical trial.

The English Illustrated Magazine. No. 3. December, 1883. London: Macmillan and Co.

THERE is little matter in this issue which can legitimately come under our notice.

"Corn-cockles" is a botanical paper of a kind with which the public are by this time very familiar, and certainly does not require the author's signature.

The "Story of a Courtship" literally swarms with dogs, like a side street in Constantinople. The constant presence of these obtrusive and mal-odorous animals in modern fiction is no pleasant symptom.

The "New Hero," amidst some apposite denunciation of cram and modern education, indulges in certain gratuitous sneers at Science. "Nor did the biologists (Frankenstein alone excepted) ever make a man." Why should they? Man is already, such as he is, a drug in the market! "What the age wants is facts." Yet the crammed child is dosed daily and abundantly, not with facts, but with fiction,—at best is fed upon words in place of things.

Association for the Improvement of Geometrical Teaching. The Elements of Plane Geometry. Part 1. (corresponding to Euclid, Books I. and II.). Prepared by the Committee appointed by the Association. London: W. Swan Sonnenschein and Co.

The traditional method of teaching geometry in strict accordance with the original work of Euclid is here much modified.

The first book is here devoted to the straight line, the successive sections treating of angles at a point, triangles, parallels, and parallelograms. Then follow problems which in Euclid are interspersed somewhat promiscuously with the theorems, *loci*, axioms, and postulates. The second book treats of the equality of areas. There can be, we imagine, little doubt that the arrangement here followed is simpler and more rational than that of Euclid.

CORRESPONDENCE.

. The Editor does not hold himself responsible for statements of facts or opinions expressed in Correspondence, or in Articles bearing the signature of their respective authors.

HEIGHT OF MEN.

To the Editor of the Journal of Science.

Sir,—In the crypt of Hythe Church are the bones of about a thousand men said to have been killed in a battle between Saxons and Danes. The size and strength of the bones are wonderful. The skulls are large and well-shaped, and have no likeness to those of gorillas except in the deeply furrowed and projecting brows. From a dozen femurs I picked one that was rather the largest, and I found it a full inch longer than my own. Taking this as a fourth of the owner's excess in height, he must have been 6 feet 7 inches. A skeleton, probably older than those at Hythe, is in Scarborough Museum, and, by rough measurement with arm-span outside its glass case, I found that the former owner was about 6 feet 4 or 5 inches. Dld not giants precede the men whose small armour has led us to deem our fathers less than ourselves? I believe that we, and especially our girls of the middle and upper classes, are growing taller. I wish some-one would compare the height of 200 or 300 girls, between 16 and 26, with the height of their mothers. I think he would find a difference of quite half an inch, perhaps more.—I am, &c.,

Hugh Browne.

STUPIDITY OR EXCITEMENT

To the Editor of the Journal of Science.

Sir,—As you appear to take much interest in anima psychology, perhaps the following instance of animal stupidity may be acceptable :—The other day some sparrows flew past my house at

the height of the second-floor windows. A cat which was walking in the garden made a sudden leap upwards, as if in the hope of seizing them, though her spring did not of course carry her one-tenth part of the height that would have been requisite.

We generally suppose that every animal has a practical knowledge of the extent of its own powers, without which, indeed, it would fare badly either in capturing prey or avoiding its enemies. Moreover, we feel warranted in concluding that it knows the powers of its enemies. Thus both cats and birds know that dogs cannot climb, and when in a tree exhibit perfect unconcern. But the cat in question, though of mature age, seemed as little able to judge of distance as is an infant when it grasps at the moon.

The only other conceivable interpretation of the leap is that Puss was excited out of her sober judgment at the mere sight of sparrows.

Another case of apparent feline stupidity may often be observed :—If a canary, or other small bird, is set in its cage near a window, a cat will often post herself on the ledge outside and stare for an hour, if not driven away, frightening the bird almost to death. Now surely every cat must have learnt, from its own individual experience, that glass if pervious to light is not so to cats.

It seems to me that the great difficulty we encounter in studying the intelligence of animals is their extreme inconsistency, or, I might perhaps better say, the mixture of rationality and irrationality which they exhibit.—I am, &c.,

H. S.

[Perhaps to higher beings human conduct might exhibit the same medley of wisdom and folly which we think we find in the lower animals.—Ed. J. S.]

EARTHQUAKES AND ELECTRICITY.

To the Editor of the Journal of Science.

Sir,—I would take this opportunity of referring to an article in your December issue on " Earthquakes," &c. In this it is stated —" It is now well established that in India, at all events, earthquakes are almost always accompanied by furious storms of thunder," &c. Now I have had personal experience of three earthquakes, my wife of one, and my sister (now with me) of two, all independently of the others. Neither thunder, lightning,

nor rain occurred with one of them. Each and all occurred without any atmospheric disturbance whatever.—I am, &c.,

W. Bull.

PLACE TO OUR ELDERS!

To the Editor of the Journal of Science.

Sir,—From time to time naturalists are still asked how they can reconcile Darwinism, or Evolutionism generally speaking, with Revelation? If I might suggest, "Society," before seeking a solution of this difficulty, should try to obtain an answer to a less recent difficulty, *i.e.*, how the tenets of modern political economy can be brought into harmony with Scriptural morality! —I am, &c.,

Truth-seeker.

THE SHROPSHIRE MYSTERY.

To the Editor of the Journal of Science.

Sir,—You have in dealing with so-called "Spiritualism" shown a decidedly benevolent neutrality, and have earned, as I can perceive, scanty thanks from both sides. You will, however, doubtless, not refuse to find a corner for the following considerations *in re* the "Shropshire Mystery," now that the alleged exposure is denied and the "confession" retracted. Setting aside trickery three cases seem to me possible:—

1. The girl produces the phenomena in question, involving destruction to property, annoyance and injury to persons, by some inherent and peculiar power of her own.
2. The girl is a "medium," through whose presence certain unseen but malignant agencies obtain facilities for doing evil. In this case she is plainly *particeps criminis*, just as much as a servant who should leave a door unlocked for the admission of burglars.
3. The mischief is produced by the malignant agencies aforesaid without the assistance of the girl and independently of her presence.

In the two former of these cases it is difficult to see that the girl is other than a criminal whose career ought to be arrested, *coute que coute*, as a danger to the community.

This consideration naturally leads me to the witch-trials of past ages. If witchcraft was a simple delusion, then, and only then, these trials and the ensuing executions were revolting outrages. But if the witches really possessed the superhuman and maleficent powers ascribed to them, or if, powerless in themselves, they enabled evil "spirits" to do mischief which would otherwise not have occurred, their elimination was then a most fortunate circumstance.

Such "mediums" are like rat-holes in a ship, or chinks in a soil-pipe, channels through which destruction and possibly death may enter.—I am, &c.,

VARRO.

THE AFTERGLOW IN THE SKY.

To the Editor of the Journal of Science.

SIR,—With regard to the singular ruddy glow observed in the heavens before sunrise and after sunset, no one seems yet to have enquired whether any similar phenomenon has been recorded as occurring after former great volcanic eruptions.

An answer to this question would go far to decide the controversy between two rival astronomers (and editors) whether the phenomenon is due to volcanic dust or cosmic dust.—I am, &c.,

T. B. P.

NOTES.

At the December meeting of the Royal Microscopical Society the death of Mr. Hugh Powell, at the age of 85, was announced. The deceased has been engaged in the improvement of the microscope since the year 1834, and his friendly rivalry with the late Andrew Ross contributed greatly to a rapid succession of improvements in the construction of achromatic microscopes. In 1840 he succeeded in making a 1-16th of an inch objective, the first produced in this country: some years later this was surpassed by him in the production of the 1-25th and the 1-50th, constructed for Dr. Beale's researches on ultimate nerve structure. Mr. Powell was the first English optician to construct objectives on the water-immersion principle, by which a vast increase in light and resolving power, together with greater working distance, was obtained. When Prof. Abbe, of Jena, demonstrated the important part played by diffraction in the formation of the microscopic images of very minute structures, and the immense gain in aperture resulting from the employment of dense media for immersion objectives in the place of water, Messrs. Powell and Lealand were the first in this country to adopt the new principle, and with such success that objectives possessing the highest aperture on record have been constructed by them. Failing health of late compelled Mr. Powell to confine his attention to computing formulæ and giving directions, which were ably carried out by his son. Mr. Powell was one of the earliest Fellows of the Royal Microscopical Society (at that time the Microscopical Society of London), having joined it at its foundation in 1840.* The object-glasses constructed under the late Mr. Powell's direction have rarely been equalled and never surpassed by those of any other optician in the world. Some of Dr. Woodward's most difficult photographic work has been accomplished by their aid, and they have rendered good service in the elaborate researches of Dallinger and Drysdale on the life-history of monads, which gave the final blow to the theory of heterogenesis, and also to Mr. W. S. Kent in his investigations on some of the most minute forms of Infusoria.

Certain meteorological phenomena are at present exciting much attention. In England the sunset skies have for many days displayed an unusually brilliant orange-red colour, whilst the moon has appeared on the south coast blue, and at London of a

* Only five of the founders of the Royal Microscopical Society now survive.

greenish blue. The sun in India is said to have been decidedly blue. We have not learnt whether its spectrum has been examined.

The "Medical Press and Circular" remarks that, in applying for medical appointments in Edinburgh, "more dependence is to be placed on being a pious Free-Churchman than on any real aptitude."

At the Meeting of the Linnean Society on the 6th ult. was read a posthumous paper by Charles Darwin, on "Instinct."

It is not generally known that Humboldt was an Evolutionist. According to Du Bois Reymond he spoke disapprovingly of the catastrophic and teleological "Essay on Classification" by Agassiz, and Parisian traditions report that he was not on the best of terms with Cuvier.

We regret to put on record the death of the distinguished American entomologist Dr. J. L. Leconte. The news reached us just too late for announcement in our December issue.

Mr. H. P. Hubbell, in a letter to the "Popular Science Monthly," describes three human footprints in a rock of magnesian limestone near the mouth of the Little Cheyenne River, in Dakota Territory.

According to the same journal Lord Chief Justice Coleridge has been put forward at Yale College to defend classicalism in education as against the study of Science. Besides very much damaging his cause, his Lordship is reported as having said "I have done many foolish things in my life,"—a most appropriate confession from an Anti-Vivisectionist.

The supposed specific bacillus of cholera has not been found to reproduce this disease in cats, dogs, swine, guinea-pigs, and rats. Mice inoculated with the bacillus have become ill.

It is very doubtful whether any portion of the profits of the Fisheries Exhibition will be applicable to the establishment of a station for the study of Marine Zoology. Popular organs denounce the proposal, and sneer at scientific investigators and their "fads."

Mr. Ivan Levenstein, in an able discourse on the decline of the coal-tar colours' industry in England, delivered before the Manchester Section of the Society of Chemical Industry, insists that only such men should be appointed to professorships as have distinguished themselves by actual research.

According to "La Nature" M. Saint Georges has devised an improvement in the telephone, by which the words spoken are registered.

M. Th. W. Engelmann, after very careful and prolonged researches, has succeeded in showing indubitably that certain Vorticellæ possess the power of evolving oxygen on exposure to light, by means of a green colouring-matter which is equally diffused in their ectoplasm, and not by means of vegetable guests. These are the first authentic instances of animals which assimilate by means of a chromophyll.

"Les Mondes" complains that "l'Hygiène Pratique," a purely non-political French journal, has been prohibited in Germany, an act explicable only by "une haine implacable pour tout ce qui est français."

Mr. G. W. Grim ("Popular Science Monthly") notices the occasional appearance of small land-birds out at sea, sometimes hundreds of miles from land, and comments on their freedom from weariness and on their tameness until approaching the land.

According to "La Nature" the mountains of Turkestan, now almost denuded, were once covered with magnificent forests.

Prof. W. G. Sumner ("Popular Science Monthly") says:—"We can never annihilate a penalty. We can only divert it from the head of the man who has incurred it to the heads of others who have not incurred it. A vast amount of 'social reform' consists in just this operation."

The Central Association of Spiritualists is being wound up, and a deficiency of £150 has to be encountered.

MM. J. Chambrelent and A. Moussons ("Comptes Rendus") have proved the presence of morbific bacteria in the milk of animals attacked by splenic fever.

Mr. Jos. Cowen, M.P., whilst distributing prizes at the Newcastle College of Medicine, complained that "the tendency of to-day was more or less in the direction of sameness and uniformity, which begat sterility and intellectual weakness."

Many animal and vegetable forms seem stationary in numbers, if not actually on the decrease. Man and those weeds and vermin which are—in a broad sense—parasitic upon him have the sad prerogative of unlimited increase.

H. A. G. Nathorst ("Botanische Jahrbücher") shows that the flora of Spitzbergen is richer than that of any other country in the same latitude. The majority of species avoid the coasts, and are mostly to be found in the interior, in accordance with Blyth's theory. Most if not all the species have immigrated since the glacial epoch, finding their way over a since submerged tract which connected Spitzbergen with Novaja Semlja, Arctic Russia, and Scandinavia. There has been no immigration of

note from Greenland, which is separated from Spitzbergen by a deep sea:

Mr. Wigner, F.C.S., in a letter to the "Times," gives some alarming revelations concerning the adulteration of milk. Of fifty samples obtained as it comes to London the total average was 7 per cent better than the standard of the public analysts. But of three hundred samples obtained about the same time from London milkmen all but ninety-seven were worse than the worst of the original samples. On the lowest computation the sum paid yearly by London for milk-adulteration is £356,000.

"Psychische Studien" and "Light" give, on the part of Gambetta and of Prince Bismarck, a number of instances of what forty years ago was considered gross superstition, such as belief in unlucky days and years, in fortune-telling by cards, in the danger of thirteen persons sitting down to table, in the influence of the moon on the growth of plants and of the human hair!

Mr. T. Mellard Reade, F.G.S., in a letter to the "Geological Magazine," maintains that the human skull found at Birkdale in 1872, on which a paper was read by Dr. Barron at the Southport meeting of the British Association, is, at a liberal estimate, not more than 2000 years old.

Prof. Dohrn's collection illustrative of the fauna of the Bay of Naples has become the property of the Cambridge Museum of Comparative Anatomy.

According to the Society for Psychic Research, impressions of odours and tastes are transferable.

The "Journal of Education" having offered a prize for "the best list of the ten greatest living English men of letters, the names selected by a majority of the candidates include three avowed enemies of Science and at least two decided Bestiarians. The name of Herbert Spencer figures near the bottom of the list!

"Science" discusses rhabdomancy, magnetic healing, &c., in an article headed "From Superstition to Humbug."

It is announced that a Zoological Society is about to be formed at Liverpool. The promoters hope to have shortly the largest and most complete zoological gardens in Europe. We hope, however, that they will be in the hands of a society, and not of a company. In the latter case they will either come to an untimely end or continue in existence by dint of attractions similar to those offered by the Royal Westminster Aquarium.

According to "Flora" the fungus *Torrubia cinerea* has been found growing upon a mature *Carabus* (species not named).

According to "Science," at the November meeting of the American Academy of Science, Dr. Graham Bell took up much time by a paper on the alleged increase of deaf-mutism, due to the existence of separate schools for those suffering from congenital deafness.

Prof. Newcome ("Science") urges that photometric determinations are comparatively valueless, because they give only a part of the radiant energy of the sun.

Dr. McCook, at the recent meeting of the Academy of Natural Science of Philadelphia, gave an interesting account of the moulting of spiders (*Tarantula*) and of the restoration of lost limbs.

"L. B." writes in "Science" on teaching language to brutes, which he thinks feasible (*see* "Journal of Science," 1883, pp. 1 and 176).

There is war, not indeed in heaven, but among the Anti-Vivisectionists! Mr. Adams, editor or late editor of the "Zoophilist," has brought an action against Miss F. P. Cobbe, and has recovered damages!

We are happy to learn that the Bestiarians have been totally defeated at Bournemouth, in spite of the Bishop of Winchester, his attending vicars and curates, and of one Mr. Vaudry, a delegate sent down from head-quarters.

M. Girard, of Lyon, has bequeathed 100,000 francs to the French Association for the Advancement of Science, for the purpose of founding a quinquennial prize for researches on the antiquity of man with reference to geological times.

From a careful study of the "red spot" on the disc of Jupiter, Dr. Lohse, of the Potsdam Observatory, concludes that this planet must still be enormously hot, occupying an intermediate position in the scale of development between the cooled and solidified planets, such as our Earth and self-luminous bodies like the Sun.

Strange to say "doctors differ" on the cause of the glow which has lately been observed in the western sky after sunset. Mr. Norman Lockyer ascribes the phenomenon to volcanic dust, whilst Mr. Proctor has no doubt of its cosmic character.

Mr. W. H. Preece argues that the mass of matter projected into the air during the recent eruptions was negatively electrified and then became subject to the repulsive force of the electrified earth, whilst the particles repelling each other caused the dust to spread over a vast area.

Sir F. Abel, F.R.S., has been elected Chairman of the Council of the Society of Arts, *vice* Sir W. Siemens, deceased.

A technological contemporary indulges in the following specimen of popular science :—" Sir Isaac Newton, the celebrated author of 'Kosmos,' was once asked how he came to make his great discoveries ? "

Prof. Holton, of Copenhagen, refutes the alleged claim of Romagnosi to have anticipated Oersted in the discovery of electro-magnetism. He shows that, according to the description given by Tommasi, Romagnosi's advocate, the phenomenon produced and recorded by the latter was not electro-magnetism.

Major-General J. F. Tennant, F.R.S. (" Monthly Notices Royal Astronomical Society "), from observations on a chronometer, is led to infer that the periodic changes in its rate are due not to variations in temperature, but in humidity.

According to the French medical papers there is now living at Aubérine-en-Royans, a village between Valence and Grenoble, a woman who has reached the age of 123 years, and she has no infirmity except deafness. Her marriage certificate bears the date 1783.

Prince Louis Ferdinand, of Bavaria, is about to bring out an anatomical monograph on the tongue in man and in the lower animals.

The " Popular Science News " declares that " English lecturers as a class are prosy and dull."

Canon Liddon, in a Lecture on Positivism,—a doctrine, to say the least, not more welcome to the scientific than it is to the religious world,—asks how could we " face the weird mystery of pain unless we felt that suffering had a purpose, and that each stone in the great temple of souls needed to be chiselled, and that each blow was dealt by the unerring hand of the Great Sculptor ?" Are we to infer that the speaker eschews every attempt to escape from or to do away with pain ?

Miss F. P. Cobbe has had the effrontery to speak of Professor Owen as an " old impostor."

An abnormal number of toes is, according to Mr. E. P. Poulton, not uncommon in cats. This peculiarity is hereditary.

A medical contemporary, *haud inepte*, speaks of water-closets as, " except when perfectly managed, mere typhoid fever traps."

TWENTY-FIRST YEAR OF PUBLICATION.

THE

JOURNAL OF SCIENCE,

AND ANNALS OF

ASTRONOMY, BIOLOGY, GEOLOGY, INDUSTRIAL ARTS, MANUFACTURES, AND TECHNOLOGY.

(MONTHLY, FORMERLY "THE QUARTERLY JOURNAL OF SCIENCE.")

Vol. VI. (Third Series)
No. CXXII.

POST TENEBRAS LUX

FEBRUARY
1884.

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LONDON:

3, HORSE-SHOE COURT, LUDGATE HILL.

Where Communications for the Editor and Books for Review may be addressed.

PRICE ONE SHILLING AND SIXPENCE

THE

JOURNAL OF SCIENCE.

FEBRUARY, 1884.

I. PROFESSOR HUXLEY'S DARWINISM.

By Oswald Dawson.

"In England the leader of the Darwinian party was Prof. Huxley. . . . That the 'Origin of Species' was driven home to men's minds by an interpreter of such power, probably cut short by some years the interval of hesitation which necessarily preceded the period of full recognition."—Prof. L. C. Miall.

"Darwin expounded and illustrated by Huxley is a most formidable combination, and one that might well quench the ardour and damp the courage of any one who wished merely to cavil."—Dr. Charles Elam.

IN 1860 Prof. Huxley, whom Dr. St. George Mivart tells us is "Mr. Darwin's authorised interpreter," assumed the "office of an interpreter between the 'Origin of Species' and the public," and he "acted for some time in the capacity of a sort of under-nurse" to the book. The appellation "under-nurse" is somewhat appropriate, for when celebrating "the coming of age of the 'Origin of Species'" by a lecture, Prof. Huxley did not mention the theory of Natural Selection,—a circumstance the more unfortunate inasmuch as *twenty years previously* he had remarked that "*twenty years hence* naturalists may be in a position to say whether" or no "species offer residual phenomena, here and there, not explicable by natural selection." According to the "Times" report of the Rede Lecture, 1883, Prof. Huxley's chief object on that occasion was "to draw a sharp line of demarcation between this great and well-vouched truth [Evolution] and all the innumerable collateral speculations which might stand or fall without touching the central core of the doctrine." This anxiety to divorce

collateral speculations from the major theory strikingly contrasts with Mr. Darwin's dexterity in confusing them.

The task here is an exposition from the technical standpoint of the several inversions and kindred tamperings with Darwinism committed from time to time by "Mr. Darwin's authorised interpreter."

The Parentage of the Origin of Species.

In 1859, in "Macmillan's Magazine," and in 1877, in the "Manual of the Anatomy of Invertebrated Animals," Darwinism seems to have meant natural selection; and "divergence" is spoken of as existing between "three views" held "among those who accept the doctrine of Evolution in its general outlines" ("Manual," p. 40). In 1880, when the "Origin of Species" came of age, "Evolution in its general outlines" apparently monopolised it, and, as remarked above and by others, natural selection was not mentioned. In 1878, in the transitional stage, the name of Mr. Wallace was thrice associated with that of Mr. Darwin, and Evolution was represented as the "irrepressible" successor of sundry conceptions chronologically intermediate between Treviranus and Lamarck and Darwin and Wallace ("Science and Culture," pp. 297, 306-308). In 1880 "the 'Origin of Species' [became] the logical sequence of the sequence of the 'Principles of Geology.' The fundamental doctrine of the 'Origin of Species'" ceased to be natural selection, or the preservation of favoured races in the struggle for life. Not a vestige of proof is offered to substantiate the implication that Mr. Darwin was ever one whit guided by deduction from the speculations of physical geology.

The Absolute and Pure Darwinian.

This "creature" ("Critiques and Addresses," p. 298) differs from the Darwinian Darwinian in that he ignores the effects of use, variation independent of natural selection, and so on. When therefore Prof. Huxley doubts whether he "can ever have seen one alive," one legitimately expects that Dr. Mivart is about to be reprimanded for "passing over the effects of the increased use and disuse of parts," &c. ("Origin of Species," p. 176). In truth, however, Prof. Huxley never mentions these topics, being himself the nearest approach to the censured creature perhaps ever yet seen alive. Let us quote him:—"What if species should offer residual phenomena, here and there, not explicable by

natural selection?" ("Lay Sermons," p. 298). "How far 'natural selection' suffices for the production of species remains to be seen. Few can doubt that, if not the whole cause, it is a very important factor in that operation" ("Science and Culture," p. 306). "But postulating the existence of living matter endowed with that power of hereditary transmission, and with that tendency to vary which is found in all such matter, Mr. Darwin has shown good reasons for believing that the interaction between living matter and surrounding conditions, which results in the survival of the fittest, is sufficient to account for the gradual evolution of plants and animals from their simplest to their most complicated forms, and for the known phenomena of Morphology, Physiology, and Distribution" ("Manual of the Anatomy of Invertebrated Animals," pp. 39, 40, and "Encycl. Brit.," art. 'Biology').

The Rôle of Natural Selection.

Prof. Huxley "never had the slightest notion" that it was other than "an iteration of the fundamental principle of Darwinism" to assert that the "action of 'natural selection'" is "subordinate" ("Critiques and Addresses," p. 299): our author maintains that variation is of paramount importance, although Mr. Darwin had applied, and repeated, an illustration in his "Variation under Domestication," to enforce the opposite lesson (1st ed., ii., 248, 249, 430; 2nd ed., ii., 236, 426).

The Causes of Variation.

Prof. Huxley tells us that Mr. Darwin "seeks for the principal, if not the only, cause of variation in the influence of changing conditions" ("Manual of the Anatomy of Invertebrated Animals," p. 40, and "Encyclopædia Britannica," art. 'Biology'), whereas Mr. Darwin tells us, in the "Origin of Species," that "Such considerations as these incline me to lay less weight on the direct action of the surrounding conditions, than on a tendency to vary, due to causes of which we are quite ignorant" (p. 107); in the "Descent of Man," that "in general we can only say that the cause of each slight variation and of each monstrosity lies much more in the constitution of the organism than in the nature of the surrounding conditions" (p. 608); in the "Variation under Domestication," that "these facts are important from showing, as remarked in a former chapter, that each trifling

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variation is governed by law, and is determined in a much higher degree by the nature of the organisation, than by the nature of the conditions to which the varying being has been exposed" (ii., 344).

Truly there is *some slight excuse* for Prof. Huxley's misinterpretation, for Mr. Darwin does once affirm that "every variation is either directly or indirectly caused by some change in the surrounding conditions" ("Variation under Domestication," ii., 415), but insists so often that variations are very remotely related to changing conditions that he must have experienced some surprise when his authorised interpreter thus distorted his views. What can be more explicit than the following? "We are driven to conclude that such peculiarities are not directly due to the action of surrounding conditions, but to unknown laws acting upon the organisation or constitution of the individual,—that their production stands in hardly closer relation to the conditions of life than does life itself" (*Id.*, i., 448, 449), "life itself" being the Creator's breath.

Mr. Darwin's real teaching is as follows: changed conditions, acting often not indeed alone upon the individual, fœtus, or otherwise, but upon its "ancestors," render the organisation plastic, variations being the result of a certain "tendency to vary" thus induced; the nature of such variations being likewise generally determined by the constitution of the subjects of the influence rather than by the peculiar nature of such influence. This Prof. Huxley abbreviates into the statement that "Mr. Darwin . . . seeks for the principal, if not the only, cause of variation in the influence of changing conditions."

To remark that "it is quite conceivable that every species tends to produce varieties of a limited number and kind, and that the effect of natural selection is to favour the development of some of these, while it opposes the development of others, along their predetermined lines of modification" ("Science and Culture," p. 307), is either to say that it is quite conceivable that Mr. Darwin's view may be correct, or that Teleology is conceivable. The truth that "the importance of natural selection will not be impaired, even if" Darwinism be proved true (*Id.*, p. 307), must puzzle fellow-interpreters; while the alternative conception of a Master of the Mint manufacturing, "along their predetermined lines," coins which he knew would be obsolete when ready for currency, is as paradoxical as the converse proposition, namely, that a variety may be "perpetuated or even intensified when selective conditions are indifferent, or perhaps

unfavourable, to its existence" ("Critiques and Addresses," p. 299). Yet Prof. Huxley, without specially alluding to secondary sexual characters, tells us "now" (1871) Mr. Darwin's "inclination" is to admit that such *perpetuation* of variations, under circumstances *unfavourable to their existence*, may occur "in the teeth of all the opposition 'natural selection' can offer," as Dr. Mivart expresses it.

Teratology and Darwinism.

In 1860 Prof. Huxley wrote as follows:—"As a general rule, the extent to which an offspring differs from its parent is slight enough; but occasionally the amount of difference is much more strongly marked, and then the divergent offspring receives the name of a Variety." Hexadactylism and Ancon sheep serve to illustrate this. In the first generation of the *Gratio Kelleia* case were two pentadactyles, one hexadactyle, and one intermediate; in the second generation were six hexadactyles, one intermediate, and five *plus* "many" pentadactyles; once there occurred three pentadactyles and one hexadactyle, and on this Prof. Huxley observes that "the prepotency of the variety was still more markedly exemplified" than when three hexadactyle and one pentadactyle were born in a family.

As to Ancon sheep, Mr. S. E. B. Bouverie-Pusey writes as follows:—"Of the other, the ancon, or otter breed, said to have originated in Massachusetts in 1791, we know much less, as it is now extinct, and we have apparently only one account of it, from a Colonel Humphreys, written in 1819, which account we have no means of controlling or verifying. I suspect that there is some mistake or exaggeration in the alleged suddenness of the appearance of this breed, and that more time and more selection was really employed than appears. We know nothing of the breed of the sheep among whom the first ancon lamb was born, but it seems (*vide* Youatt) that the sheep of America were in a highly mongrelised state,—a condition* extremely favourable to reversion. We have also reason to believe that this form has been observed in Europe, and therefore may be considered as a race of unknown origin (*vide* Isidore Geoffroy St. Hilaire 'Histoire Naturelle')" ("Permanence and Evolution," pp. 51, 52).

Referring to the *Kelleia* family, Prof. Huxley remarks that

* According to Darwin "Animals and Plants under Domestication," vol ii., p. 13, *et seq.*

"If a variation which approaches the nature of a monstrosity can strive thus to reproduce itself, it is not wonderful that less aberrant modifications should tend to be preserved even more strongly" ("Lay Sermons," p. 267),—a paraphrase of Mr. Darwin's statement that "If strange and rare deviations of structure are really inherited, less strange and commoner deviations may be freely admitted to be inheritable" ("Origin of Species," p. 10), although pangenesis removes a rudimentary organ when much reduced ("Variation under Domestication," ii., 309, 393).

The Ancon sheep chosen by Prof. Huxley as a typical instance of "less aberrant modifications," Mr. Darwin has taken the opportunity to remark, "throw very little light on our subject" ("Origin of Species," p. 201); they are "semi-monstrous" ("Variation under Domestication," i., 104); in common with hexadactyle men their behaviour in respect to inheritance differs from that exhibited by races formed by selection and by hybrids (ii., 70, 72). We have seen that they lack an unassailable history; also that a mistake occurs in the recordal of the Kelleia case. Consequently those whose conversion to Darwinism was accelerated by Prof. Huxley's unintentionally unsuitable interpretation may fitly re-examine their views.

The Sterility Desideratum.

We will now proceed to examine a chimera with which Prof. Huxley encumbered Darwinism. Persons may be reluctant to believe this unless I discuss the topic at some length, especially, perhaps, since Prof. Huxley once reproached Dr. Mivart for "creating a difficulty for Mr. Darwin out of a supposed close similarity between the eyes of fishes and cephalopods, which (as Gegenbaur and others have clearly shown) does not exist" ("Critiques and Addresses," p. 253),—not to dwell on the fact that Dr. Mivart did not "create" the difficulty, but borrowed it with acknowledgment on more than one occasion, including the one quoted by Prof. Huxley, in both editions of the "Genesis of Species," from "Habit and Intelligence."

Unfortunately Prof. Huxley is not quite clear what the "little rift within the lute" really is. In 1860 "the production of mutually more or less infertile breeds from a common stock" was the desideratum; in 1863, in some lectures to working men which the author had "no leisure to revise," "complete physiological divergence" was demanded, and if it should be proven impossible to obtain this

"Mr. Darwin's hypothesis would be utterly shattered." In "Man's Place in Nature" (pp. 107, 108) the little rift was still unhealed. In 1864, though still "the weight of this objection is obvious" ("Lay Sermons," p. 308); "the difficulties presented by hybridism" were classed among "details," "so battered and hackneyed on this side of the Channel that not even a Quarterly Reviewer could be induced to pick them up for the purpose of pelting Mr. Darwin over again" (p. 318); though it is not obvious why the alleged terror of Quarterly Reviewers should have induced an authority such as M. P. Flourens, when conducting an "Examination du Livre de M. Darwin sur l'Origine des Espèces," to ignore Mr. Darwin's ninth chapter; nor did such alleged terror of Quarterly Reviewers deter Prof. Huxley from reprinting from the "American Cyclopædia" his statement that "what is needed for the completion of the theory of the origin of species is, first, definite proof that selective breeding is competent to convert permanent races into physiologically distinct species," in the same issue of the "Popular Science Monthly" in which appeared the editorial announcement of certain lectures in which some fossil horses were pronounced demonstrative evidence of evolution (August, 1876). It had become expedient to offer a modified estimate of the necessity of manufacturing mutually infertile breeds from a common stock; else how good a cartoon for a scientific "Punch"—the triumphant horse and the obstreperous mule trotting out to tournament, the one as "demonstrative" evidence of evolution, the other concerned in some plot to "utterly shatter" that doctrine.

It will be observed that the "utterly shattered" quotation is but an intensified repetition of what may be an erroneous view taught in the "Lay Sermons." Were it not so I should be more reluctant to quote from an unrevised volume, though it is one of the four "chief works consulted" by Miss Arabella B. Buckley in the composition of successive editions of her "Short History of Natural Science." In this work "young and unscientific people" are informed that the "one stumbling-block" to Darwinism is the circumstance that "we have never yet been able to trace out two varieties of an animal which have become so different that they do not pair together;" and as the author proceeds to discourse upon choice, and never mentions sterility, one assumes the desideratum is distinct from that sought by Prof. Huxley,—not the production of physiological, but of emotional, properties;

though those able to appreciate the difference between the "only one difficulty" and "almost the only *real* one" may be more competent to determine whether Miss Buckley's desideratum is a counterfeit of Prof. Huxley's or no.

The inaccessible nature of the evidence destined, if forthcoming, to utterly shatter Darwinism, is its conspicuous feature; something must be proven impossible; though whether a dozen, a score, or a hundred failures will suffice to prove the impossibility of breeding races mutually infertile from a common stock, no notion whatever is afforded. The fabric resembles the logic of the desideratum. First comes the assumption (not explicitly adopted by Prof. Huxley in its integrity) that "species" under Nature are sterile, much evidence to demonstrate the unwarrantableness of which is given by Prof. Karl Semper, in his contribution to the "International Scientific Series"; and then the assumption that "the antipathy of wild animals of different species for one another, or even of wild and tame members of the same species, is ordinarily so great that it is *hopeless to look for* such unions in Nature" ("Lay Sermons," p. 273). Evolutionists possess, however, some very hopeful evidence on this point; Prof. Semper cites above half-a-dozen such instances, and Mr. Darwin tells us that "a female Australian dingo in England attracted the wild male foxes" ("Variation under Domestication," ii., 80), also that "the Indians of North America cross their half-wild dogs with wolves" (i., 21); again, "strange as the fact may appear, many animals under confinement unite with distinct species as freely as, or even more freely than, with their own species" (ii., 133, &c.), and he gives evidence that certain animals breed more successfully with other species than with members of their own. These several facts are not calculated to sustain the expectations of those who "will go so far as to express our belief that experiments, conducted by a skilful physiologist, would very probably obtain the desired production of mutually more or less infertile breeds from a common stock, in a comparatively few years," when "it took Mr. Wicking thirteen years to put a clean white head on an almond tumbler's body, 'a triumph,' says another fancier, 'of which he may be justly proud'" (*Id.*, ii., 183). Prof. Huxley's "comparatively few years" ("Lay Sermons," p. 295) means "a long time" (p. 273).

In the circumstance of the difficulty of crossing the common rabbit and *Lepus Huxleyi*, Prof. Haeckel discerns the realisation of Prof. Huxley's wish. Mr. S. E. B. Bouverie-Pusey, however, offers criticisms, and adduces evidence that

the Porto Santo rabbit did not "as certainly originate since the year 1420," as Mr. Darwin believes.

But the strongest argument (to many readers) against the validity of Prof. Huxley's objection is yet to be mentioned, namely, that Mr. Darwin himself, so far from believing that his theory would be utterly shattered by the everlasting failure to obtain the desideratum, insisted on more than one occasion—even in the very first edition of the "Origin of Species"—that "as domestication (I do not mean mere confinement) apparently tends to eliminate sterility, we ought not to expect it also to produce sterility" (p. 461): again, he writes—"Some eminent naturalists believe that a long course of domestication tends to eliminate sterility in the successive generations of hybrids which are at first only slightly sterile; and if this be so, we surely ought not to expect to find sterility both appearing and disappearing under the same conditions of life" (p. 269; in 6th ed., pp. 257, 263, and 405). These quotations are utterly ignored by Prof. Huxley, who actually declares that "Mr. Darwin is perfectly aware of this weak point" ("Lay Sermons." p. 295).*

"Certain naturalists," writes Mr. Darwin, "have recently laid too great stress, as it appears to me, on the difference between varieties and species when crossed," so he forthwith proceeds to levy an ingenious argument against these anonymous naturalists ("Variation under Domestication," ii., 174, 175). He enquires, "Why, then, should these [differences in fertility] be thought of such paramount importance in comparison with other incidental and functional differences? No sufficient answer to this question can be given." Mark, *en passant*, Mr. Darwin's dogmatic style.

Now the circumstance that "there is no certain evidence of offspring ever having been produced by a male and female mule" ("Lay Sermons," p. 272) seems to be the corner-stone of the desideratum. It may not be the happiest illustration, for the horse and ass *belong to different genera*. Possibly the progeny of horses and rhinoceroses, or horses and hippopotami, are sterile.

But supposing a skilful physiologist rendered an imaginary extant common ancestor of the horse and ass the bifurcating

* In the "Variation under Domestication," Mr. Darwin remarks that the fertility of the varieties of domestic animals, when crossed *inter se*, "is extraordinary," but "not so extraordinary as it at first appears" (ii., 82). *Cf.* "Origin of Species," p. 256, to same effect; also p. 236. Miss Arabella B. Buckley in her counterfeit presentation of the desideratum adopts a similar procedure.

stem of brand new horses and asses, whose progeny were sterile *inter se*; yet supposing both these novelties neighed, or both brayed, another series of experiments would be necessary to prove that diversity of voice is not diagnostic of special creations alone. Further, since "it *matters not one whit* whether this sterility is universal or whether it exists *only in a single case*" ("Lectures," p. 146), human language is as indictable as mule sterility; yet Prof. Huxley would assuredly be reluctant to join the school of folks who demand that the orang-outang shall converse with his keeper before the doctrine of our Simian origin shall be conceded qualified for other than provisional acceptance!

It may be incidentally appended that the mule exhibits very much that dilatoriness of reproductive power, so to speak, which an evolutionist might anticipate. Female mules may cross with the parent horse. In France, some years ago, a female mule produced foals two years in succession to an Arab sire, "Land and Water" informs me; while the view that male mules are impotent is partially contradicted by facts, for the hybrid from an ass and zebra has crossed with a mare ("Variation under Domestication," ii., 16). Nor can the testimony of Aristotle be summarily rejected, since he not merely affirms their fertility with mares, but specifies the age known as puberty in our own species, and in addition gives the proper name for the progeny ("History of Animals," Book VI.).

As Prof. Owen, annotating John Hunter (the dog-wolf progeny of a friend of whom re-crossed with a dog), has remarked, this capacity of a hybrid to cross with a pure species has not the same import as fertility *inter se*. The mule likewise corroborates the Pallasian doctrine, an extension of which, as we have seen, interferes with the "little rift within the lute"; for "Dureau de la Malle, who has so closely studied classical literature, states that in the time of the Romans the common mule was produced with more difficulty than at the present day" ("Variation under Domestication," ii., 88).

Finally, if mules were fertile, *inter se*, the advocate of the creation of physiological species could retreat a step or so, and insist upon the production of jumarts fertile *inter se*,—a jumart being the reputed offspring of a bull and a mare. But I am trespassing beyond the limits of this section—the discussion of *the sterility desideratum*.

The American Addresses and Darwinism.

The previous section shows that Mr. Darwin recognised in the phenomena of hybridism nothing subversive to *Evolution,* though he conceded the sterility of hybrids is little, if at all, explicable by *Natural Selection.* Now the theory which was to be utterly shattered, if the logical feat of proving something impossible were accomplished, was, according to Prof. Huxley, "Mr. Darwin's theory," and this association of the sterility desideratum with Mr. Darwin's theory has justified its examination here. The horse of the "American Addresses," on the other hand, is demonstrative evidence of "Evolution;" so it may suffice to remark that a portion of this same pedigree is utilised by Dr. Mivart to substantiate his saltatory hypothesis; to hint how suitably it may be chosen to illustrate the effects of "use"; to point out that if parallelism of specific evolution, independent of inherited tendency to vary along parallel lines, be animpediment to Darwinism, horses possibly furnish an impediment; also to remind the reader that if, as urged by Dr. Charles Elam, it is permissible for a specific creationist to maintain the specific identity of *Equus* and *Orohippus* (*Eohippus* too?), the propriety of reversing matters, and pronouncing fossil *Sauropsida* "demonstrative" and fossil horses "favourable" evidence of evolution, suggests itself;* and to remark that if the occurrence of special creation and special extinction be not improbable, *à priori,* the latter may be summoned to explain the absence of aboriginal American horses.

But the "American Addresses" are by no means devoid of Darwinism, inasmuch as its supremacy is maintained with no less confidence than in "Man's Place in Nature," the reason assigned for this supremacy being that persistence is compatible with it; and as any evolutionary theory in which progress is made a necessary contingent suffers patent suicide, Darwinism seems naturally preferable. The truth is, however, that the "neutrality" of the testimony of persistent types is debateable, and that it would have harmonised better with Mr. Darwin's own views had none persisted, as the following quotations from the "Origin of Species" will show:—

* *Eohippus* was described by Prof. Marsh the month following the delivery of the American Addresses; and not only it, but *Orohippus* and *Mesohippus* may be dispensed with without interfering with the "demonstrative" nature of the evidence (p. 84). *Vide* also "Manual of the Anatomy of Vertebrated Animals" (p. 305).

"Such a case would imply that one form had remained for a very long period unaltered, whilst its descendants had undergone a vast amount of change; and the principle of competition between organism and organism, between child and parent, will render this a very rare event" (pp. 265, 266); "they will, during each successive age, have to be slightly modified so as to hold their places in relation to slight changes in the conditions" (p. 308). "When any of the inhabitants of any area have become modified and improved, we can understand on the principle of competition, and from the all-important relation of organism to organism in the struggle for life, that any which did not become modified and improved would be liable to extermination" (pp. 291, 292). And that Prof. Huxley, as a Darwinian, would have welcomed with more composure the absence of such persistence, may be inferred from the fact that he speaks of the existence of these types as a "*circumstance to be wondered at*" ("Lay Sermons," p. 219). This was in 1862, when "observation and experiment upon the existing forms of life" was "the only way in which it [progressive modification] can be demonstrated" (p. 226). In the following year, when lecturing to working men, Prof. Huxley pronounced the circumstance "something stupendous."

Supposing persistence explicable by Darwinism, how is the supremacy of that theory thereby established? That earlier speculators may have considered progress a necessary contingent no more damages the pith of their view of modification than the circumstance that Mr. Darwin restricted the mode of action of natural selection will cause the general theory of selection to be annihilated should the restrictions imposed by him prove to have been unwarranted,—a question beyond the scope of this article.

It is singular that once upon a time Prof. Huxley, if I understand him aright, insisted that—viewed from another standpoint—persistent types furnish *not neutral*, but, by discrediting catastrophic and periodic-creation theories, *very favourable* evidence of evolution. Had all Prof. Huxley's evolutionary writings been inspired by the moral wisdom of the brief paper of June, 1859,* he would never have earned

* It is possible that Prof. Huxley was here advocating the view that the entire modern fauna and flora have persisted from a remote geological epoch, but that, owing to "the imperfection of the geological record," only a few forms are known to have done so. The important passages are given in the "Historical Sketch" of the "Origin of Species"; in addition to which is the concluding sentence, which runs as follows:—"In fact, palæontology and physical geology are in perfect harmony, and coincide in indicating that all we know of the conditions in our world, during geological time, is but the last

the ingratitude of evolutionists by the installation of palæontology as "the only perfectly safe foundation for the doctrine of Evolution" ("Manual of the Anatomy of Invertebrated Animals," Introduction, p. 41). Those who prefer to advocate or refute the doctrine of our Simian origin not as a mere deduction, or upon the strength of the sparse palæontological material at present available, have especially reason to be vexed.

Preceding the epilogue is a digression on Geological Time, wherein "the uninformed" are reproached for discerning "a solid foundation" for the belief that sufficient past time is not at the evolutionist's disposal.

"I desire to be informed," said the lecturer, "what is the foundation for the statement that evolution does require so great a time"; but Mr. Darwin never complied with the request. His uninformed readers may, however, answer as follows:—"We borrowed from the 'Origin of Species' itself our information that '140 million years *can hardly be considered as sufficient*' for pre-Cambrian evolution, and that 60 million years 'appears *a very short time* for' post-Cambrian evolution (p. 286). Further, we find it repeatedly insisted upon in the 'Origin of Species' that evolution by natural selection must be an extremely slow process, while on pages 269, 270 we notice a passage which we think it legitimate to interpret as meaning that under Nature we must not expect to find a breed '*sensibly* changed in the course of *two or three centuries*.'"

One smiles when watching Prof. Huxley thus correcting "the uninformed," Mr. Darwin combatting "certain naturalists," and neither mentioning the other personally.

The Simplicity of Darwinism and Teleology.

That Prof. Huxley should have found out that "the 'Origin of Species' is by no means an easy book to read—if by reading is implied the full comprehension of an author's

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term of a vast, and, so far as our present knowledge goes, unrecorded progression" ("Proc. Roy. Inst.," June 3rd, 1859). *Cf.* that speculative treat "Illogical Geology" in Mr. Herbert Spencer's "Essays: Scientific, Political, and Speculative" (vol. i.), published the following month in the "Universal Review." Or—and I had thus understood Prof. Huxley when writing this section—it may be that he considered persistent types favourable evidence, inasmuch as he thought philosophers would be reluctant to ascribe to the Creator the performance of an operation so whimsical as the repeated destruction and re-creation of a few favoured forms,—or their specially permitted survival of catastrophies extirpating the remaining fauna.

meaning" ("Lay Sermons," pp. 256, 257)—is not surprising: he calls it "a mass of facts crushed and pounded into shape, rather than held together by the ordinary medium of an obvious logical bond"; the bond being "often hard to find," and only discoverable on the application of "due attention." When understood, however, "the Darwinian hypothesis has the merit of being eminently simple and comprehensible in principle" (p. 292); furthermore, the general view of the universe is simpler than that offered by the advocates of specific creation (Lecture VI. of the "Lectures to Working Men"). Mr. Darwin, on the other hand, does "not wish to lay much stress on the greater simplicity of the view of a few forms or of only one form having been originally created, instead of innumerable miraculous creations having been necessary at innumerable periods" ("Variation under Domestication," i. 12).

This question we cannot pursue, nor can we here discuss any niceties of distinction between Teleology as commonly understood and Teleology as otherwise understood, but simply point out that "that which struck the present writer most forcibly on his first perusal of the 'Origin of Species' was the conviction that Teleology, as commonly understood, had received its death-blow at Mr. Darwin's hands" ("Lay Sermons," p. 301), whereas Mr. Darwin maintains that "whether or not" slight variations, &c., are ordained, the outcome manifests purpose ("Descent of Man," p. 613). $3+5=8$ (an even number). But unfortunately teleological intuitions are less persuasive than arithmetical calculations, even when fortified by Bridgewater Treatises, Analogies of Revealed Religion, correspondence with celebrated divines, and proficience in divinity ("Origin of Species," ii., 422) for a pamphlet,* and sundry periodicals,—*e.g.*, the "Academy,"—have made public the fact that Charles Darwin gave up Christianity when 40 years of age, and that he was with avowed Atheists in thought, though he preferred the term "agnostic." Visitors to Westminster Abbey may calculate that his fortieth birthday anniversary was a decade anterior to 1859.

Mr. Darwin's Reticence.

Prof. Huxley has judiciously abstained from allowing to his review of Prof. Haeckel's "Evolution of Man" ("Academy," January 2, 1875) the publicity accorded to his critique on the "History of Creation," namely, incorpora-

* The Religious Views of Charles Darwin. By EDWARD B. AYELING, D.Sc. Freethought Publishing Company. 1883.

tion in a collection of essays. The notoriety of the review reposes on the assertion that concerning our Simian origin "Mr. Darwin has had leisure to state his views more fully, though not more distinctly than in the 'Origin of Species,' in the 'Descent of Man,'" and the repudiation with unqualified scorn of the allegation that Mr. Darwin had been reticent on the topic.

"Much light will be thrown on the origin of man and his history." Is this *the most distinct* mode in which Mr. Darwin proclaimed our Simian origin? Was it so monstrous a supposition that the philosopher who required a Creator to breathe life into primeval forms might not also stand in need of a little supernatural aid to make a man? Not reticent when, in the first edition of the "Origin of Species," it was announced that sexual selection had probably contributed to *differentiate* mankind, and when not a hint was given that it may also have assisted in *originating* our species? Not reticent when "during many years I collected notes on the origin or descent of man, without any intention of publishing on the subject, but rather with the determination not to publish"? Not reticent when,—that his coward kin might inhale with lessened shock the breath which vivified the primordial one, or few, whose progeny were to be for countless æons of a yet-continuing Time, "from the hour of their birth to that of their death," subjects of a struggle involving scenes which to the "imagination" of him whom Prof. Huxley declares "left untouched" the question of the origin of life, it were "FAR MORE SATISFACTORY* to look at . . . not as specially" ordained, and evolving "contrivances . . . abhorrent to our ideas of fitness,"—not reticent, I ask, when, to compromise with his victims, he first announced that natural selection, besides forming species, might affect "*even* orders," subsequently that *classes* might be involved, and that "at the most remote geological period the earth may have been as well peopled with many species of many genera, families, orders, and classes, as at the present day," till by-and-bye he conducted them to the "four or five" patriarchal animals (i., radiate patriarch; ii., molluscan ditto; iii., articulate ditto; iv., vertebrate ditto; v., Adam—why not?) and the "equal or less number of plants, when at length the "probably deceitful guide" Analogy broke the barrier between the two kingdoms, and apparently also between the living and the non-living, disclosing the "laws impressed on *matter* by the Creator" and

* This quotation is copied here from the "Origin of Species."

the "few beings which *lived*" before the deposition of the Silurian; this penultimate scene finally yielding to the restitution of the renowned Creator's breath ("Origin of Species," 1st ed., pp. 125, 191, 126, and the 'conclusion').

Will one who dare deny Mr. Darwin's reticence be dismayed by an anachronism? Not so. In "Critiques and Addresses" (xii.) Mr. Wallace is made to pose as one of "Mr. Darwin's critics," notwithstanding the circumstance that his "contributions" were incorporated in book-form in 1870, the year before Mr. Darwin's "Descent of Man" was published. He may have been a "critic" of the "Origin of Species"!

Concerning natural selection and Dr. Mivart's opinion that that theory is associated more exclusively with Mr. Darwin's name on account of Mr. Wallace's reticence, Prof. Huxley, after pronouncing the opinion "simply ridiculous," remarks that "if there was any reticence at all in the matter, it was Mr. Darwin's reticence during the long" time he postponed publishing the "Origin of Species"—that is, till he availed himself of the circumstance that Mr. Wallace communicated his discovery to the Linnean Society through Mr. Darwin himself.

Whether Mr. Darwin was prolonging his reticence for the purpose of accumulating factual evidence, or whether he deemed "the masses not yet ripe" for the promulgation of his theory, Prof. Huxley does not speculate; nor need we here, for the expediency of reticence or aggressive candour, the propriety of pious frauds and their Darwinian analogues, concern us here as little as the "Nature" Memorial Notice.

II. THE DEVELOPMENT OF OXYGEN BY PLANTS AS AFFECTED BY THE INTENSITY OF LIGHT.

IT is popularly known that light, and of considerable intensity, is needed for that most important process of plant-life the decomposition of carbonic acid and the liberation of pure oxygen. That such an operation takes place few will care to dispute. That its results approximately compensate for the respiration of animals, though not proved, is generally admitted. But the series of experiments hitherto conducted with a view to ascertain the laws of this phenomenon left much to be desired. Accordingly the eminent botanist J. Reinke has made a further investigation of the subject, the results of which we will here summarise.

As a measure of liberation of oxygen he took the number of air-bubbles thrown off by a water-plant in a given time. He threw upon the plant light concentrated by means of a lens, measuring the intensity in each experiment by the distance of the plant operated upon from the focus of the lens. As the subjects of the experiments he selected the points of young shoots of the well-known water-weed *Elodea Canadensis*, which were found to throw off a constant current of air-bubbles equal in size. These shoots were placed in well-water through which a current of air had been passed for a short time. The rays of light were caused to fall normally to the surfaces of the leaves.

Observations were made both with increasing and decreasing intensities of light. The plant was exposed to each degree of intensity for half to one minute before the result was taken, and the number of bubbles was then counted in two intervals of a quarter minute each. The temperature did not rise during the experiments more than 3° C., and ranged during the different sets of observations between 20° and 21° C.

None of the plants examined gave off gas-bubbles at intensities of light equal only to 1-24th of normal sunshine. Between the intensities of 1-16th and 1-4th the number of bubbles increased proportionally to the light,—*i.e.*, from four to twenty. A corresponding, but of course inverse, phenomenon was observed in the decreasing series. But at the intensity 1 (= normal sunlight) there was only twice as

much gas given off as at $\frac{1}{4}$, and on further increasing the intensity to 8 the quantity of gas eliminated remained constant.

There is therefore a maximum speed of liberation which is reached probably below the intensity 1, and on further increase of intensity neither rises nor falls. This maximum may also be called the optimum point, but the light-optimum differs from the temperature-optimum by remaining constant on further increase of light.

Herr Reinke gives the results of his experiments on different plants between the intensities 1-16th and 16, in seven tables, and sums up the results in the following proposition :—" The liberation of gas from *Elodea*, depending upon light, begins at a medium grade of illumination, and rises with the increasing intensity of light to a maximum which corresponds approximately with direct sunlight, and is reached sometimes at a slightly lower, and at other times at a slightly higher, intensity, whilst a further increase of intensity produces no further increase of the liberation of gas."

Herr Reinke next emamined the liberation of oxygen on a further augmentation of the intensity of light up to the point at which the destruction of the chlorophyll and the death of the cells occur. For this purpose a large lens was employed, and the distances were calculated for the intensities 1 (= normal sunlight) up to 64. In order to guard against the rise of temperature due to the concentration of the sun's rays, which would complicate the results, the light was passed through a trough 9 inches in width, made of plate glass, and filled with a saturated solution of alum. During the experiments the rise of temperature did not exceed 4° to 6° C.

These experiments showed that up to very great intensities the number of the gas-bubbles given off was constant. Nor could any difference in the rate of the liberation of bubbles be detected when ordinary sunlight and such light concentrated sixty-four times were allowed to fall alternately upon the plant. In the most concentrated focal light a spray of *Elodea* continued to give off thirty-eight to forty gas-bubbles for a quarter of a minute, as before. Not until after an exposure of two minutes did the current begin to slacken. Fewer bubbles escaped, and at irregular intervals. After five minutes the development of gas came to an end, and on microscopic examination it was found that a great part of the surface of the leaflets was entirely bleached.

From these experiments it is plain that, even in the most

concentrated light of the focus of a burning-glass, the evolution of gas goes on at its ordinary maximum rate until the injurious action of the light becomes manifest and the chlorophyll is destroyed.

As regards the theory of the action of light, Herr Reinke deduces from his researches the following conclusions:—He believes that the liberation of gases observed in his experiments is an approximately accurate standard for the rate of the elimination of oxygen, and may thus again serve as an approximate expression for the decomposition of carbonic acid. He considers that the consumption of oxygen in the green cell vanishes in comparison with the liberation of oxygen. This fails to hold good at low intensities of light only when the proportion between the oxygen produced and consumed is different.

The fact that in intense and increasing light the liberation of oxygen remains constant in quantity, remains to be examined in the light of the various theories concerning the *modus operandi* of chlorophyll.

According to one view the chlorophyll acts physically as a protective screen during the decomposition of carbonic acid. It is here assumed that an increased oxidising action of the oxygen proceeds parallel with the growing intensity of the light. As now the above experiments prove that even in the most intense light there is neither an increase nor a decrease of the liberation of gas, we must suppose either that (1), with the increasing intensity of light, the decomposition of carbonic acid and the oxidation increase exactly proportionally, which, considering the complete mutual independence of the two processes, is little probable, especially as such a connection certainly does not appear during a decrease of the intensity of light; or (2), we must assume that the curve of the intensity of oxidation is quite different from that of reduction, so that in the intense light the former diverges much from the latter, and that therefore the gas which is given off in the most intense light contains an increased proportion of carbonic acid.

Herr Reinke has submitted this consequence of the latter assumption to an experimental test. He collected the gas which was given off in $1\frac{1}{2}$ hours from *Elodea* sprays exposed to an intensity of light between 64 and 300 times that of ordinary sunlight. The temperature of the water had risen during the experiment from 20° to 29° C., and at the conclusion the two upper sprays, which had been most intensely illuminated, were completely bleached, whilst the others remained perfectly green. The collected gas amounted to

G 2

4·2 cubic centimetres, and contained 5 per cent of carbonic acid, or not more than is found during the action of ordinary sunlight: the remaining 95 per cent consisted of oxygen, with an undetermined admixture of nitrogen. Hence Reinke infers that the liberation of oxygen observed does not well agree with the theory of a physical mode of action of the chlorophyll.

If we start with the assumption that the activity of the chlorophyll in the decomposition of carbonic acid is chemical, this chemical function of a given mass of chlorophyll cannot—under the most favourable conditions—liberate more than a certain absolute quantity of oxygen. This exactly agrees with the result of the above experiments. It appears that the maximum liberation of oxygen from *Elodea* occurs at an intensity of light sometimes a little higher, sometimes a little lower, and sometimes coinciding with that of normal sunlight. A further increase of the intensity remained ineffective, but no injurious effects upon the liberation of oxygen were perceived until the chlorophyll was destroyed by the oxidising action.

It has been known with certainty since the end of the last century that the liberation of oxygen by plants is a function of chlorophyll. The direct proof has only lately been given by Engelmann that oxygen is given off exclusively by the chlorophyll granules, and that these alone act as organs of the decomposition of carbonic acid in the cell. A further step is thus taken rendering it probable that no substance other than chlorophyll under the impulsion of sunlight chemically mediates the decomposition of carbonic acid. We know that this process takes place in the chlorophyll granules only, and that consequently some substance present in these granules must be the effective agent. Hence it seems most natural to ascribe this function to the chlorophyll itself.

It is not sought to deny that, in addition to this function, chlorophyll may play an important part in protecting the cell from light. Along with the principle of the division of labour in Nature we encounter also the principle of the cumulation of functions. That such a function of protection from light may have profound significance for a plant is shown, *e.g.*, by the investigations of Berthold. Many sea-weeds escape the direct action of sunlight by their locality, whilst others equip themselves with the most manifold and curious protective arrangements. Wherein lies the injurious effect of direct irradiation, which is

doubtless the foundation of all these adaptations, it does not yet appear. That high light-intensities do not depress the decomposition of carbonic acid is certain; that ordinary sunlight effects no increased combustion appears also certain. Other effects must therefore exist by which intense light is injurious to many plants.

III. LATENT THOUGHT.

By D. Y. Cliff.

REMARKABLE incidences of parallelism in thoughts are constantly occurring in every-day life, and in the wider field of human history, where whole races "think alike," and often it is the civilised world. Is it not a wonder a man is never born who thinks totally different, not only in style, but in logical sequence, to his fellow-man? Nor is this nonsense, for I believe it is J. S. Mill who has said it is conceivable that there may be a species in the solar system with whom two and two make five.

It is worthy of notice, if we will think on the matter, how every thought we think is mentally expressed in our vernacular. Unpremeditated sentences spring out of our minds without an effort, but they must have been arranged internally before directing the vocal muscles. Is a thought spoken before it is considered, however swiftly?

I am inclined to think there is a continuous train of thoughts in our mind of which we are not aware, either of its existence or its laws,—a necessary result, so to speak, of the brain or nervous "molecular motion" or "vibration," and it is only when we require "to language" it that it is brought into activity. Surely mental activity must be constant, as we see with dreams: perhaps we are only aware of dreams in the interval between awaking and sleep.

I have heard of missionaries who became so used to the barbarous tongue in which they taught that they came to "think in it." Is there latent thought? This latent thought would naturally be hereditary in a family, a race, a nation, or even the human species, and would do away with

any astonishment that no logical "confused" man is born. The brain, being part of the body, cannot be exempt from the same causes that rule the body—evolution, correlation, &c. Of course this latent thought is a very dim, vague sort of a thing to define.

It would seem only certain that a constant relation, or proportion, is generally a law of thought. For instance, two persons look at a colour, and call it "red." How are we to prove that they both see identically the same effect? Each always sees one *constant result*, and he has learnt to call it "red," and so with the other person, although it may really be green to one and blue to the other, in their relative individual judgment. This of course is no detriment to our thinking, but it shows there may be wide differences unknown to us. Perhaps every one of us has a different picture of a man; we have only learned things relatively to ourselves. We pity the poor frog who, with a partially brainless skull, answers with a meaningless croak the stroke on his extremities; but are we much better—*i.e.*, any different—in principle? It is but a more complex affair. We get a kick, and our anger is roused, all our nervous system s disturbed, and the tongue utters harsh sounds, like the frog croaked. Then there is the restraintive power of the human mind; but animals have that too.

In this latent thought lies the nature that maketh all the world akin; how alike is every human emotion! Is there any difference in the love language of a Savage and an Englishman?

There are certainly traits of (latent?) thought in a nation's literature. How dull we find Oriental history, until it has time after time got thoroughly imbued with an European way of telling its story. Strange it is, too, what the effect of style is on writers; extracts from dry books seem to keep dry; writers on Oriental history (*e.g.*, China) seem unable to throw off its tone. We have literal translations of Chinese stories; what "stuff" they seem to the English mind! And yet often they approach very near. Colenso gives a Gala religious rhapsody; it is as good as a Psalm (which are by-the-bye the product of a very different stage of civilisation to the present).

We cannot help being struck by the art productions of the Aryan, Semitic, or Hamitic division of the human race. The difference is most striking. One would venture to suggest that the sculptural remains of ancient nations might be taken as decisive testimony as to their respective races.

The stiff, hard drawing of the old Egyptian, Assyrian, &c., can never be confounded with the more exact conformity to the natural shapes of the Europeans, and most decidedly stamps this relative "latent power" of the respective races. And here it is not entirely "surroundings" that have formed their ideas of beauty—a principle one of your correspondents argued for in a former number. This might explain the very peculiar drawings of the Chinese or Japanese, but cannot be applied to the ancient world, unless we unfoundedly suppose that their forms—contours of limbs—were as harsh as designed, which is absurd, and would not have escaped the notice of the early European historian. The hideous sculptures of Indû gods can hardly be the work of an Aryan race. Nor is it an accidental turn of thought like the nepotism of Travancore, Cochin, &c.

The human mind cannot conceive anything, as Mr. Cook, of Boston, has shown, and the "why?" of that question is only to be answered on the hereditary principle, our ancestors not being able even to guess the confines of space and time: yet still there are moments when we fancy we have an idea,—but the world is in our brain.

IV. ON SANITARY REFORM.

By Rev. SAMUEL BARBER.

III.

IN the case of children receiving elementary education the Government has demanded that a certain cubical space shall be assigned to each individual: this is a grand principle of sanitation now recognised and enforced by the Law. Inspection of lodging-houses is partly based on the same truth, *viz.*, that oxygen is essential to human life. Let us hope that this scientific axiom may receive a still further recognition at the hands of legislators, and that the inspection may become still more comprehensive. Why should school-buildings and lodging-houses monopolise the attention of sanitary authorities when ordinary dwelling-houses are shamefully overcrowded and vilely ventilated?

Why should a manufacturer suffer penalties for discharging noxious gases in a town when the local authority is suffered, with impunity, to ventilate senselessly-constructed sewers by opening, in front of our parlour-windows, apertures for the exit of a poisonous gas much more evil in its effects than the hydrosulphur fumes which chemists delight in. A case is before the writer at present, in a town (let us call it Blackhaven) where several of such wretched ventilators discharge their disgusting effluvia right in front of a terrace of houses, which become at times, in consequence, hardly habitable. To add to the indecency, a large school pours forth its crowd of children close to the place, and nothing delights them more than to carry on their games right over these pernicious and abortive devices.

It would appear to an ordinary mind that the *raison d'être* for a sewer is that it shall remove far away those dangerous results of organic life which, strictly speaking, it is the office of earth to neutralise; but if you discharge excreta into a drain, and then ventilate that drain by letting off the gas generated within it right among a crowd of human beings, you commit an absurd action, and are likely to receive, as a recompense, your labour for your pains. And here it may be right to enquire, in the name of mechanical science, if it is a thing impossible so to trap the outside pipes that a method of *driving* out the gas may be applied; and also whether a little more design cannot be exercised as to the position of the outlet pipes and the *elevation* at which they operate? We are accustomed to be told by engineers, concerning almost every variety of mechanical blundering in sanitary matters, that there is no want of power on the part of Science to apply a remedy; it is only a *financial* question. There is doubtless much truth in this remark. And we may again take note how much the conditions of human life are affected by the ideas of "what ought to be done" possessed by those in power; in other words, by the character of their moral and physical standards. This is a fact which may be realised in its physical bearing with regard to what we term "dirt," by an examination of the various aspects of scavenging presented in our different towns. Clearly, either the local regulations must vary vastly, or the ideals of purity possessed by local magnates must be almost as wide as the poles asunder. Thus we often hear that such a place is a "clean little town," another a "filthy hole." This differentiation in the matter of dirt may be witnessed by comparing the better class of towns in the South of England with those, for instance, which lie on the Cumberland coast.

There is one of these latter (which we will not name) where the prevailing notion with regard to "Matter in a wrong place" seems to be briefly comprehended in a saying once used to the writer by a cottager whom he was visiting:—"It's *all* clean dirt, sir." In this town, where'er the "casual eye" of the visitor is cast, solid and liquid filth of various dye arouses his slumbering indignation, and his final conclusion, after a full survey of the sanitary conditions of the place, is that "these people love to have it so." It's all clean dirt to them. Money, says Bacon is like muck, not good except it be spread. And it would appear that the inhabitants of the town referred to partly appreciate this remark; though it seems to one intimately acquainted with local affairs that they do not spread their money in order to manage and utilise the muck, but stick fast to the filthy lucre, while they display to the greatest possible disadvantage (of pedestrians) the varied qualities of the dirt, so that it may meet the eye at every turn!

But, with all gravity, we may venture to affirm that this is not merely a financial question. We shall not probably be far wrong if we regard it as one chiefly dependent on popular education. We can hardly hope to witness the full application of Sanitary Law till our working population is animated not merely by the craving for knowledge, but by an earnest desire to exhibit, in all the phases of social life, that right economy of force which we denominate "material justice."

In spite of the introduction of Science teaching among the people, the vast majority of our population remain—and will doubtless continue for some time to come—in a state of darkness respecting Sanitary Science. But the problem of improving public health consists not merely in the diffusion of knowledge, but in the application of moral and religious principle to the outward forms of life.

Clergymen, district visitors, and others might often do good, if well informed themselves, by pointing out violations of Sanitary Law to the poor. Ignorance itself is a powerful force, continuous in action and cumulative in its disastrous effects; the practical observance of law is, on the other hand, ever potent for good. A moderate acquaintance with physical law would often be of priceless value to those in the lowest walks of life. But, unfortunately, laziness and indifference are too often in contention with knowledge; the kindly warnings of Nature become, in time, a dead letter; familiarity has destroyed perception. To many of the inhabitants of our city lanes filth and disorder give no

feeling of uneasiness; the foulest of stenches scarcely produces a feeling of aversion. Yet we shall be doing great injustice to the poor in attributing such conditions entirely to their own action. Much of this mischief must come from conditions of life entailed upon them by the truly marvellous economy (to put the matter mildly) which builders, landowners, and architects have exhibited, with respect to space, in the arrangement and construction of dwellings.

V. ON TECHNICAL EDUCATION.

By Robert Galloway, M.R.I.A.

(Continued from vol. v., page 604.)

In the last article I stated that I would propose a scheme less costly and more efficient than the Department of Science and Arts' plan, prefacing the description of the scheme by showing what could be accomplished in Evening Science Schools, by describing what has actually been accomplished in Evening Science Classes in Chemistry. But before entering on these topics it appears to me desirable to notice one or two of the views put forward on Science teaching at the British Association, and Social Science, meetings, last autumn.

The first I will notice was that proposed by Mr. Lant Carpenter. The essence of his system, he stated, was the employment of a specially appointed Expert, who should go from school to school with *his apparatus, repeating the same lesson in each.* He said the system was conceived and elaborated during the last few years by the Liverpool School Board. In this he is totally mistaken; as far back as 1859 the respected Keeper of the Mining Records in the School of Mines, Mr. Robert Hunt, established this system in Cornwall under the name "The Miners' Association." He gave a detailed statement of the system, as to its working, &c., in 1868, to the Select Committee appointed by the House of Commons to inquire into the provisions for giving instruction in Theoretical and Applied Science to the industrial classes; and his evidence is fully set forth in the

Committee's Report, which was printed in that year by order of the House of Commons.

That system, in my opinion, would never in the long run aid in promoting the progress of sound Scientific and Technical Education: granted that the teacher when he first entered on his duties was not only thoroughly in earnest, but had the greatest enthusiasm possible for his task, how long would that earnestness and enthusiasm last? How long could he take that real and ardent interest in his pupils, which all true and effective teachers must take, in all the schools he visited? The teaching given under such a system must after a time degenerate into a mere matter of routine with the teacher; and an energetic man would try to escape from the thraldom by seeking some other employment more congenial to his altered views and wishes, and also more remunerative, for he would soon learn by experience that he could look for no advancement as a teacher, and therefore, if he continued to teach, it must be the same dreary round year after year, *repeating the same lesson in each*, until failing strength rendered him incapable of continuing it, and he would by that time have become unfitted for any other employment.

But what would be the remuneration for teachers of this class? The teacher in Cornwall received £100 a year at the time Mr. Hunt gave his evidence; but if we are to take the average amount paid by the Department of Science and Art to Science teachers as the STANDARD, it is evident that the scale of remuneration, for this class of teachers at least, is decreasing; for the average payment per teacher given by the Department in 1869 was £40, and in 1880-81 it was £24 13*s*. 11*d*., being a decrease of more than 38 per cent. Such a teacher as Mr. Lant Carpenter describes, unless he got situated in a locality more than usually favourable in the cause of scientific education, or he had some means of his own, might end his days in the poorhouse. But Mr. Carpenter appears to be unaware that such a system has forced itself on many of the Science teachers under the Department, owing to the small and precarious sums they earn on the *result system*. In the last article it was shown that in some cases the remuneration the teacher of an experimental science received was less than 2¼*d*. per hour for the time he was occupied in preparing for and giving a lesson: this *lavish* remuneration, it will be observed, did not extend to the full hours of a working day, but only for the time he was occupied; whereas the Dock labourers in London, who are considered to belong to the lowest class of labourers in

that city, are paid at the rate of 5*d.* per hour throughout the entire working day, if they are constantly occupied, and the occasional labourers are paid at the rate of 6*d.* the hour.

Science teachers, like unscientific people, could not keep body and soul together on the rate of remuneration of £1 for twenty-eight lessons; they have therefore—in order to eke out what in some cases, after all has been done, will amount but to a bare subsistence—to teach in many schools, often also many subjects, and to devote an amount of time each day to teaching, which is directly in opposition to the system pursued in German schools. In the article in the February number (vol. v.) it was shown, from the Department's own Reports, that some of them taught in as many as *nine* different schools.

The *great decrease* in the average payment per teacher which has taken place within the last few years is, in my opinion, a most significant fact; it must be due, it appears to me, either to the employment at the present time of a class of teachers inferior to those employed in 1867, or it must be due to the departmental officials cutting down the earnings of the teachers, which—according to the late Sir Henry Cole, as shown in the January article (vol. v.)—was the chief, if not the sole, reason for instituting *the payment on result system.*

If the decrease in the average payment is due to the present teachers as a body being inferior to those employed in 1867, it indisputably proves, I think, that the young men, who have within the last dozen years or so been not only provided through the Department with a scientific education free of all cost, but have also been paid by the State—in the form of exhibitions, scholarships, &c.—varying sums for maintenance during the time they were studying, have not, after completing their studies, entered as teachers to any appreciable extent under the Department; otherwise, if the decrease in the average payment is not due to the cutting down of the teachers' earnings, but is due to the inefficiency of the teaching, it would prove that more efficient teachers were to be had before the Department took the training of them in hand than since that time.

The following sums appear in the Estimates for 1883-84 for exhibitions and maintenance allowances for those of the State-aided students who are sent to the Normal Science School, South Kensington:—

Exhibitions and Maintenance Allowances.

12	Exhibitions, at £50 a year, tenable for three or four years	£600
4	Scholarships, of £15 each	60
2	Scholarships, of £25 each	50
50	Teachers in training, at £1 1s. a week	1900
200	Teachers for short courses, £2 each ...	400
268		£3010

The plan which appears to have very generally come into vogue within the last few years, of forcing the student attending lectures on any of the Inductive Sciences to take down in his note-book, as completely and perfectly as possible, the *very words* the lecturer utters, and some time after submitting the copy to the lecturer or his assistant, and being questioned upon the lectures at stated times, either by a written or *viva voce* examination, appeared to be a method very much approved of at one of the two autumnal meetings I have already referred to; it is therefore deserving of notice.

The method of teaching the Inductive Sciences by means of Lectures, especially if they are not rendered catechetical, is a most irrational and delusive plan as far as the student is concerned, for the lecturer does not know how the instruction he is giving is being *mentally* received by his different hearers,—whether the words he utters remain passively in the mind as mere words, or, if not passively received as mere words, whether the mind is forming correct or incorrect ideas upon the subject lectured upon; the students might as well be "stocks of wood or stone," so far as the lecturer is aware how the instruction he is giving is operating on their minds.

The only advantage a lecture on an experimental science has over a book, the book having many advantages over the lecture, is this,—the student *sees*, or ought to see, the experiments performed at the lecture, whereas he only *reads* about them in the book; the difference corresponds to the difference between seeing a picture and simply reading about it. But with regard to such a non-experimental science as Geology, if it is not taught in the field, but only in the lecture-room, a standard work on the science well illustrated with diagrams is superior, almost in every respect, as a teaching agent, to such unpractical and unnatural teaching;

for a book is ever at hand to be consulted, and the student can peruse and refer to those portions of the subject which he does not at the first thoroughly comprehend; whereas the words uttered by the lecturer, if not understood at the time they are uttered, in most cases produce no after mental effect, ceasing even to be remembered as mere words.

Even as a method for cramming students for examinations the mere attendance on lectures has been found to be inoperative with the majority of students; hence the adoption of the system which has just been described, of compelling as far as possible the students to take down the exact words the lecturer utters; it may be more efficacious than the system it has superseded in cramming students, but what is it but the vicious system of rote learning carried out to its fullest extent? It leaves the intellect uncultured, for it forces, as far as it can, the student to be a mere passive recipient of others' ideas, and it prevents him, as far as can, from being an active inquirer and self-instructor. Even when students are not compelled to take down the exact words, they are very apt of themselves to fall into this rote system if the lectures are not made catechetical: the Examiners for University work in great towns have directed attention to this failing in their Reports; they have stated that the written answers on several of the questions taught contained not much more than a reproduction of what had been said by the lecturers; they were a repetition of formulated phrases, in place of an intelligent assimilation and reproduction of their general purport.

But what will be the condition of a student if he is taught by an ignorant teacher who adopts this rote system: would not the study of a good standard work on the science, even if the science were an experimental one, be far preferable to the utterings of such a teacher? And that there are such teachers abroad those who have been behind the scholastic curtain are aware. On one occasion a note-book, owned by a student who was being taught on this rote system, was placed in my hands; the part of the book to which my attention was directed had been signed correct by the *professorial* teacher: it consisted of a series of chemical equations, which were intended to describe the chemical changes which take place in the different forms of the galvanic battery; although signed correct by the Instructor every one of the equations was incorrect, and the errors were so glaring that they proved unmistakably the great ignorance of the subject which existed in the minds both of the teacher and the taught. If this sad lack of knowledge

is met with amongst teachers styled Professors, what can be or ought to be expected from teachers who are paid at the rate of £1 for twenty-eight lessons?

Unfortunately, in this land of educational endowments, ignorance is not solely confined to the teaching body; it extends sometimes to the examining body. In looking over examination papers it is not difficult to see that the questions set sometimes have been arrived at by the Examiner simply reading some book on the subject. I have met with one or more very curious instances of this, but to narrate them would carry me too far away from my present subject, and therefore I will resume the consideration of the lecture system.

A combination of practical work and thought is as necessary to obtain a knowledge of any of the inductive sciences as it is to obtain a knowledge of arithmetic; hence if any system of teaching is adopted for teaching any one of these sciences in which thought and work are not combined, information may, but knowledge certainly cannot, be acquired. The lecture system of teaching does not admit of the students combining work and thought; hence it cannot educationally be regarded as a method by which scientific knowledge can be acquired; nor is it rendered more efficient in this respect by compelling the student to write down the words the lecturer utters. To render lectures as efficient as it is possible to make them, the catechetical system must be adopted: by this system the attention of all the students remains unabated throughout the entire lecture, and by being converted from *passive* into *active* agents they take a great pleasure in the instruction given; and by being asked and asking questions all understand, as far as they can without experimenting themselves, the subject lectured upon. By adopting this method I have found students to be more deeply interested, if possible, in organic than in inorganic chemistry, whereas, by the professorial system of lecturing, as far as my experience extends, it is the branch of chemistry least liked. It is greatly to be regretted that the system of teaching by lectures is the prevailing system for teaching the Inductive Sciences, and that it is the system most frequently employed for teaching beginners; much more could be accomplished during the time the majority of students can devote to study if a more rational educational system were adopted.

In teaching evening classes in Chemistry, some years ago, I adopted a practical system of teaching from the first lesson onwards, which caused work and thought to be

combined; and I consider that results were obtained that have never been equalled—I will even go so far as to say approached—in evening classes, even in the very highest scientific schools, not only in the United Kingdom but in other countries, including Germany. It is necessary, in making this claim on the part of myself, not only to state the results obtained, but also other particulars in connection with these evening classes, so that others may be able to judge whether the claim I make is substantiated by what was accomplished by the students. And I think the facts I shall state will not be without interest to many at the present time, when so much is being said about Scientific and Technical Education.

Some teachers, I have no doubt, would be able to reply that they have also taught Chemistry practically from the very commencement of the course of instruction they gave. It is therefore necessary to show wherein the difference, as I think, exists, in an educational point of view, between the system pursued by others and the system I adopted, and in doing so I shall discuss the question as I would any other scientific problem. I think it will be admitted that I am not far astray when I state that if an elementary practical course be given, it is usually given on the plan set forth in Part I. of the small work by Mr. Francis Jones, entitled "The Owens College Junior Course." This course does not differ in any essential particular from that adopted by lecturers, with the exception that the student in the one case, and the lecturer in the other, performs the experiments. In neither case, as I think, is the course founded on true psychological principles; it is taught by these systems as it might have been, and was, taught when all that was known of the science of Chemistry consisted of little more than a number of isolated facts.

The first and great object in teaching any subject—whether classics, the deductive or inductive sciences—is the training of the intellectual faculties, in other words increasing and strengthening the reasoning powers; the second object is to furnish the mind with material upon which to reason, conjoining knowledge and the power to wield it, thus bringing, as it has been stated, all Nature under one sway. It will not be denied that the system of instruction which is the most perfect in training the intellectual faculties is the one which furnishes the mind in the best manner with material on which to reason; and if the teaching is of a kind that does not to any extent assist in training and strengthening the reasoning powers, the information

conveyed will not be made a part of the learner's own intelligence; he cannot therefore reason upon it, and therefore he will not be able to apply it.

Chemistry is more difficult to teach, from an educational point of view, than any of the other inductive sciences; it consists of such a multitude of facts without apparently much connection, and to fill the mind of the learner with any amount of these disconnected facts, which is the sort of teaching most usually adopted, is not the teaching best adapted for increasing and strengthening the reasoning powers, and, further, it does not furnish the mind with the scientific material in the best form on which to reason. Yet, from a wide and varied experience, I have found it is capable of being taught by a system which renders it a most efficient agent for training the intellect and storing the mind with material of the greatest interest for it to reason upon, and usefully to apply.

Instead of commencing the teaching of the science by showing that two elements, A and B, can combine together, and so going on through a series of combinations of the different elements, which is the plan usually followed, the students are taught by my system, *once for all*, by means of a few experiments, that all the elements are capable of uniting with one another; and they at the same time learn, by the aid of these experiments, that the *conditions* necessary to bring about their union vary, and also the phenomena which attend their combinations. This is a generalisation that I have found all, from 12 years old upwards, are capable of grasping, whereas the majority of students are bewildered when they are taken through the maze of combinations given in the course usually followed. By a similar generalisation they are made acquainted with the combination of compound bodies. The conditions which favour the decomposition of compound substances were next studied. The experiments in this part of the course were performed by each individual learner, each of them being *separately superintended and instructed*. They were taught at the same time the language of the science, as a language, by means of exercises; they thus obtained a complete mastery over it. By no other system is the student taught the language as a language, and without a knowledge of it he is without the instrument and nutriment of thought, and from ignorance of it the atmosphere in which chemical thought lives is wanting.

I have dwelt upon the teaching of the elementary portion of the Science at greater length than I shall the more

advanced portions, because I believe it is the portion of the Science which is the worst taught at the present time, yet it forms the foundation on which the further cultivation of the Science must rest, and therefore the system which most conforms to the laws of mental evolution ought to be the one followed, both for the purpose of rendering the Science as efficient an agent as possible in training the intellectual faculties, and for the purpose of promoting the more successful cultivation of it.

Qualitative analysis was the next branch of Practical Chemistry taught; in the previous course they had been made practically acquainted with the principles on which separation of substances from one another rests; quantitative analysis next followed, and finally chemical research. The Institution in which this instruction was given was a Government one, under the Department of Science and Art, called at that time the Museum of Irish Industry.

The amount of metal in most of the specimens of the ores of copper, iron, lead, and silver, and the assay of all the samples of coal employed in the manufacture of gas, and the estimation of the tannin in the different tanning materials, exhibited in the public museum attached to the Institution, were estimated by these evening students; the rest of the specimens were analysed by my day students. The researches carried out by a number of the evening students was published in various journals; I send a copy of one, "On the Comparative Value of the different Feeding Substances for Horses," to the Editor of this Journal, and I think he will admit it is as complete as it would have been if it had issued from the Laboratory of Sir J. B. Lawes and Dr. Gilbert. Sir Lyon Playfair, M.P., visited the Institution officially just as he was on the eve of terminating his connection with the Department. I asked him to visit my Evening Classes; he did so, and he stated openly to the students that he knew of no instruction of like excellence given in any other institution, and they were fortunate in having such a teacher.

I will mention two more facts, and will then pass on to other matters of interest. A young man in the Excise presented himself one evening, and told me he wanted to get into the Excise Laboratory in London, but he had been rejected in Chemistry at the Entrance Examination; he had one more chance, and wanted to be prepared. I told him I prepared no one to pass examinations; if I had I could have filled my department three or four times over; I taught, I said, the Science, and I left the taught to apply

it: he remained, and some six months after he competed again, and obtained the first place in Chemistry. Some little time after he had been in the Excise Laboratory, he, along with the other students, was examined by Dr. Hofmann; they had a written, a practical, and a *viva voce* examination: my old student got full number of marks in each. Dr. Hofmann inquired of him who first taught him Chemistry; Dr. Hofmann wrote to the Excise authorities and stated he had never met with a like case, and recommended them to grant him a special prize.

The last case I will narrate is a proof of the benefits the country might derive from the researches of evening students; the estimation of the tannin in the different tanning materials attracted the attention of English tanners, and some time after they formed a Society for the purpose of ascertaining the best tanning materials and the best practical method for estimating the tannin: one of the members wrote to me—we were strangers personally—asking me if I would let some of my students carry out the research, and they would give them £30. I was pleased, because it showed that strangers had confidence in the work of my students. I consented, but was unable to have it carried out, as a bitter persecution by permanent officials was commenced against me at that time; this was after Sir Lyon Playfair had left the Department.

I will now come to the class of students who attended these classes, and the cost. The students were of all classes and of all ages: there were doctors of medicine in practice, medical students, pharmaceutists, owners and managers of chemical factories, young men in smelting works and gas works, photographers, soap, manure, and soda-water manufacturers; and several of the younger students were able, from the instruction they received, to afterwards start chemical works of one kind or another. Many of them used to come from distant parts of the country. I found both day and evening students all apparatus and chemicals; and although I had large classes, both day and evening, I was able to accomplish this for £125 the year, including all the necessary expensive apparatus.

I believed I was accomplishing a good work, for it is the kind of education that is most required in Ireland. I therefore spared neither labour nor time; I was in the Laboratory from 10 a.m. till 10 p.m., with only an hour and a half interval, and then from 10 p.m. till 3 a.m. I was busy at work preparing lessons; it was during those late hours that my "Second Step" was written.

Yet it was when when this beneficial work was being more and more appreciated, the Science and Art Department determined to break up the Institution, and have, in place of this advanced technical instruction, a few popular science lectures delivered in another place. Gentlemen who had been students with me united with another gentleman to defeat this; a Parliamentary inquiry took place, and the late Sir H. Cole and Col. Donnelly were defeated, and the Institution was saved and re-christened. It is now called the Royal College of Science. For this I was never forgiven, at least by one party.

I have narrated these facts, and I shall when I come to show the necessity for a Minister of Education relate a few more, in order to give the public some real information about one of the most extravagant Government Departments of the day, which unless it is thoroughly reformed will strangle real scientific education in the future, as it has done in the past.

I must leave the description of my scheme for the next article.

VI. ON ANIMAL CHLOROPHYLL.

WHETHER chlorophyll is an exclusively vegetable product, or whether it is also elaborated by certain members of the animal world, is a question which has been not unfrequently discussed of late years without any decisive result. Recently, however, a series of researches on the chlorophyll of the lower animal forms has profoundly shaken the faith in a genuine animal chlorophyll. Morphological, physiological, and chemico-physical observations have shown, or seemed to show, that the chlorophyll-granules found in rhizopods, sponges, polypes, and ciliata are merely distinct vegetable individuals, Algæ, which inhabit the animals in question in a semi-parasitical manner, just as do Algæ and Fungi in lichens.

It need scarcely be said that, if such is universally and exclusively the nature of the chlorophyll observed within the bodies of animals, it is the great and certain feature by which animals and plants are distinguished from each other. This generalisation, cannot, however, as yet claim our acceptance, since Herr T. W. Engelmann ("Pflüger's Archiv. für Physiologie") has published certain observations which, to say the least, must render the above-mentioned assumption very questionable.

Some years ago Engelmann met with Vorticellæ whose tissues did not contain distinct granules of chlorophyll, but displayed a diffused homogeneous green colour as if from imbibed chlorophyll. As at that time the occurrence of animal chlorophyll was not questioned, he paid no further attention to these animalcules. Now, since the closer investigation of this colouring-matter has become of capital importance, he returned to the subject. He met with the necessary specimens only after long search, and in small numbers. He found upon *Vaucheriæ*, both living and dead, along with numerous colourless specimens of *Vorticella campanula* and *V. nebulifera*, a few Vorticellæ of a diffused green colour. In addition to their colour, these were distinguishable by the closer and more delicate annulation of their bodies, and by a greater transparence of their endoplasm. The green colouration was strictly limited to the ectoplasm. In recent specimens the colour was quite homogeneous. It was deepest in the so-called cuticle, and was wanting on the surface of the peristomal disc. The entire endoplasm and the long nucleus seemed to contain not a trace of chlorophyll. In different specimens, however, both the intensity and the distribution of the colour were found to vary.

The important question whether living chlorophyll—or at any rate a genuine, assimilating chlorophyll—was present was investigated by Engelmann by means of the so-called Bacteria-method. He added a small quantity of a liquid containing bacteria to a drop which contained a bright green *Vorticella* attached to a dead branch of *Vaucheria*. The latter was free from chlorophyll. The preparation was placed in the "dark box" of the microscope, and the *Vorticella*, by means of a suitable arrangement, was illuminated by a spectrum. After about a quarter of an hour a distinct accumulation of movable bacteria was seen round the *Vorticella*, whilst previously none or but few had been seen.

Without doubt these Vorticellæ possess the property, by

means of the diffused green colouring-matter of their ectoplasm, of evolving oxygen under the stimulus of light. Thus we have here the first undoubted animals which assimilate by means of a chlorophyll forming part and parcel of their own living structure, and not by the mediation of vegetable guests.

The fact that the bacterial reaction, as regards its slight intensity, may be compared with that of Infusoria, which harbour living chlorophyll granules to some extent, is explained by Engelmann by the consideration that the assimilating colouring-matter was present only in very small quantity. Further, the Vorticellæ themselves consume much of the oxygen liberated, so that they can throw off but little externally. The Vorticellæ, indeed, as the author has proved by a series of observations, have a great need of oxygen,—a fact which agrees well with the supposition that they can prepare a supply for themselves.

Herr Engelmann has instituted further experiments in order to decide whether the colouring-matter of these animalcules is identical with the chlorophyll of plants, or whether it is a peculiar and merely analogous chromophyll. To this end the assimilative energy in the various colours of the spectrum was tested by means of the "Bacteria-method." Its behaviour was found similar to that of the green colour of plants. The colouring-matter was next obtained in the form of globules, and examined with the spectroscope. There was found a well-marked absorption-band in the red, between B and C, and an absorption at the extremity beginning with F. These peculiarities testify for the identity of the colour of the Vorticellæ with vegetable chlorophyll. Finally a series of chemical reactions were applied, especially that of concentrated sulphuric acid. The results still confirmed the identity of the two colouring-matters.

It is to be regretted that the scarcity of green Vorticellæ put for the present an end to these researches. In the meantime the facts ascertained suffice to put an end to the doctrine of the exclusively vegetable nature of chlorophyll. Even if it could be proved that the pigment of these Vorticellæ was ultimately derived from a vegetable source the fundamental principle would remain unaffected. For the principle is that there are animals which by means of a pigment combined with their own living plasma, and not to be distinguished from the chlorophyll of plants, are able to assimilate under the stimulus of light exactly as do green vegetables.

It is not probable that the green *Vorticella* is the only

animal which assimilates by means of its own chlorophyll. Years ago the author believes that he has met with specimens of *Cothurnia crystallina* of a diffused green colour. It may also be asked whether the blue, brown, violet, and other pigments found in a diffused state in the ectoplasm of various Infusoria are not genuine chromophylls, comparable with the xanthophyll, cyanophyll, rhodophyll, &c., of the Algæ? Here is a wide field for research, and especially for the application of the Bacteria-method.

Is it not possible that in certain cases portions of animal plasma may have become differentiated "pseudo-Algæ,"—chromophyll-granules? Is it not judicious to pause before pronouncing every coloured corpuscle, occurring in an animal, resembling a small Alga and evolving oxygen in the light, to be a guest or inmate of vegetable origin?

ANALYSES OF BOOKS.

The Agnostic Annual, 1884. New and Revised Edition. London: H. Cattell and Co.

THIS pamphlet, both in itself and in the circumstances connected with its appearance, is a phenomenon worth the heedful notice of all readers. Its editor seems to have drawn up three questions and sent them round to a number of "distinguished scientists and honoured thinkers." The questions put to these representative men are:—"(1) Whether, in your opinion, Agnosticism is in accord with modern science? (2) What is its special relation to popular theology? And (3) Whether you believe it is destined to supplant religious supernaturalism?"

As far as we can glean from the text, certain of the parties thus interrogated—whoever they may have been—did not respond at all. Others seem to have answered, indeed, but requested the editor to "regard their communications as private." A third body in their replies made no such proviso, and their opinions have accordingly been published in the form of a symposium. The names of these gentlemen are Prof. T. Huxley, Pres. R.S., Mr. P. A. Taylor, M.P., Prof. F. W. Newman, Prof. Ernst Haeckel (of Jena), and Mr. J. Beal. In addition we find the opinions of "G. M. McC.," of W. Stewart Ross, Charles Watts, "Ignotus," W. B. McTaggart, W. Sadler, and "Julian,"—all recognised as advocates and champions of what is commonly known as Free-Thought.

Foremost stands the reply of Prof. Huxley. The President of the Royal Society here informs the world that he, some twenty years ago, invented the word "Agnostic,"—an instance, we may add, of his well-known propensity for the coinage of names. It was, he further tells us, "to denote people who, like myself, confess themselves to be hopelessly ignorant concerning a variety of matters about which metaphysicians and theologians, both orthodox and heterodox, dogmatise with the utmost confidence." He further tells us that "Agnosticism is honoured by especial obloquy on the part of the orthodox." He adds that he has "a sort of patent-right" in "Agnostic," and that it is his "trade-mark." Having thus asserted his claim to say what Agnosticism is and is not, he goes on to answer the three questions. "Agnosticism," he rules, "is of the essence of Science, whether ancient or modern. It simply means that a man shall not say

he knows or believes that which he has no scientific grounds for professing to know or believe."

It might here, perhaps, be asked by a doubter what is the exact meaning which the learned Professor attaches to the words "scientific grounds"? We have heard of eminent *savants* being compelled to retract their assertions, thus proving that their grounds for "professing to know" were not truly "scientific."

Turn we to the second question and reply:—"Consequently Agnosticism puts aside not only the greater part of popular theology, but also the greater part of popular anti-theology.

We venture here to submit that this second question is scarcely needful. If we are not, except on what are commonly called "scientific grounds," to say that we know or believe anything, not merely "the greater part of popular theology and anti-theology," but much more will have to be given up as devoid of a sound basis.

Thirdly, and lastly, Prof. Huxley has "no doubt that scientific criticism will prove destructive to the forms of super-naturalism which enter into the constitution of existing religions." He adds, however, as a saving clause, "There may be things, not only in the heavens and earth, but beyond the intelligible universe, which 'are not dreamt of in our philosophy.' . . . . Agnosticism simply says that we know nothing of what may be beyond phenomena." Might it not have been judicious here to add that we do not know phenomena save as changes in our own consciousness?

Such, then, are Prof. Huxley's opinions on Agnosticism, expressed with his usual force and clearness. As such they were printed and put forth to the world in the first edition of the "Agnostic Annual," wherein Prof. Huxley's name ranked foremost among the contributors. The first impression was quickly sold out, and the publishers of the "Annual" found it desirable to issue another edition. Accordingly Mr. C. A. Watts wrote to Prof. Huxley, under date November 16th, asking if he wished to "make any correction in or addition to" his communication? Probably to his surprise he received the following reply:—

"SIR,—I shall be obliged if you will inform me by what authority you have printed and published a *private* letter which I addressed to you, and have announced my name as one of the contributors to a publication *of which I never so much as heard* until I received a copy from you. My answer to your letter of the 16th inst. will depend upon your reply to these two questions. —Truly your obedient servant,

"T. H. HUXLEY.

"C. A. WATTS, Esq."

We must first call the attention of the reader to the words which we have italicised, and then refer him to the original letter

of Mr. C. A. Watts (of September 13th), in answer to which Prof. Huxley wrote his "communication." Mr. Watts wrote—"I have undertaken to see through the press a publication entitled the "Agnostic Annual," &c. As Prof. Huxley answered this letter, his assertion that he "never so much as heard of" the Annual becomes difficult to understand.

Secondly, as Prof. Huxley's communication was solicited with special reference to a work in course of preparation, the inference lay near at hand that it was intended for publication. Yet he did not take the very obvious course of marking his letter "private," though in the second communication of Nov. 18th he speaks of it as such.

Thirdly, it appears that though Prof. Huxley had received an advance copy of the Annual he allowed nearly three weeks to pass over without protesting against the publication of his "private" letter, and the announcement of his name as a contributor. This also is not easy to understand. A man who conceives himself aggrieved generally complains at once.

The correspondence proceeded until November 26th, when Prof. Huxley wrote to Mr. Watts as follows:—"My private (*sic*) letter, which you have published as a 'contribution' in your 'Annual,' does not contain anything of importance which may not be found in my published writings, so that the question as to the withholding of the publication of my views does not arise. Nor has your act caused me any further annoyance than that which every man feels when he is treated dishonourably."

Here the public will do well to note that Prof. Huxley does not in any way repudiate his answer to the three questions. On the contrary, he re-indorses it by proclaiming it substantially identical with what may "be found in his published writings." If so, why his anger? But the fact remains that what might be found scattered, and to some degree merely implied, in his works, is in his "communication" openly and clearly expressed and brought to a focus. As such it will fall into the hands of many who have never read his works, and of many more who may have dipped into them without getting a complete acquaintance with their teachings. As such it has not escaped the notice of the public press. As such, too, certain questions will be raised which might otherwise have been allowed to sleep. We only hope that we are not doomed, in consequence, to a second cataclysm, such as that brought on by the "Belfast Address."

Whether Prof. Huxley comes out of this contest as unscathed as we might wish a President of the Royal Society to do is a question which we may safely leave to our readers The effects of his last letter were not, however, what he perhaps expected. The publishers of the Annual—who, in deference to his position and merits, had previously determined, at a considerable sacrifice, not to issue the projected second edition—now resolved to

reprint the work at once, with the whole of the correspondence and with notes.

Mr. Stewart Ross combats the impression that "Agnostic" is a name adopted by certain "advanced thinkers that they may evade the popular odium of Atheist." He asks "Am I Theist or Atheist? Define *Theos*, and I will tell you. The subject could now only be discussed in a tap-room."

Mr. P. A. Taylor, the tutelary genius, if we remember rightly, of the Anti-Vaccinationists, replies to the two former questions very much in the same manner as does Prof. Huxley. To the third he answers, "Agnosticism being, as I take it, purely negative, I do not see how it can supplant anything."

Prof. F. W. Newman, who declares himself not an Agnostic, but one who "believes that something can be known, and is important to be known, concerning God," says, as touching the first query, "If by Modern Science is meant Materialistic Science," he cannot imagine that any discord between its researches and Agnosticism could be possible. On the contrary, to Christian Theology it is a flat contradiction. That it will supplant Super-naturalism he considers doubtful. He points to the interest taken in "the ever-changing form of Spiritualism," and reminds us that in Ancient Greece and Rome a belief in astrology and necromancy increased as fast as disbelief in the popular religion."

Prof. Haeckel thinks that his Monism "agrees in all essential points with that philosophy of Nature which in England is represented by Agnosticism." He does not venture to decide the question how far Agnosticism is in a condition to influence the popular theology of the masses.

Mr. James Beal considers that the chances in favour of the acceptance of Agnosticism by the majority are for the moment small. He refers, in confirmation of his view, to "the revival and comparatively rapid spread of Theosophy."

"Julian" holds that Agnosticism is "quite as dangerous and full of mischief as theological faith."

May it not be said that the "Church Agnostic," as the President of the Royal Society terms it, carries in its bosom the germs of not a few divergent sects?

A question strikes us as regards the Introduction. We read there of "every liberal system," and of "uniting all liberal thinkers." Would not a definition, or at least explanation, of the term "liberal" be useful?

Solar Physics, an Almanack of the Christian Era. By A. H. Swinton. London: W. H. Allen and Co.

Have the sun-spots a definitely recurrent period of increase and decrease,—a maximum alternating with a minimum? So say astronomers not a few who have made it their especial business to watch for years the aspect of the sun. They maintain, further, that this alternate waxing and waning of disturbance in the solar photosphere occurs in a cycle of from ten to twelve years. Thus, in a table in the book before us, we find the years 1860, 1870, and 1882 laid down as those when sun-spots were most numerous. At the intermediate dates, 1867 the spots were fewest. Here, then, there can be no scope for argument. Nothing but prolonged observation can show whether the spots have a period, and, if so, of how many years does it consist?

We come now to the second question: admitting the cyclical character of the sun-spots, and ascribing to them—provisionally at least—a period of from ten to twelve years, we ask can a corresponding cycle be traced in any terrestrial phenomena? Many observers here reply in the affirmative. They trace a periodicity in the occurrence of earthquakes, tempests, floods, severe frosts, heat-waves, &c. Not less is the organic world said to be similarly affected; inroads of destructive insects, pestilence, cattle-plague, diseases in crops, commercial depressions, wars, nay even social and moral phenomena, such as outbursts of fanaticism, "revivals," political "reforms," and the like,—all, it is asserted, display the same periodicity. From an *à priori* point of view there is here nothing to be sneered at. To pronounce it impossible for one series of phenomena to be causally connected with another is extremely rash, until close observation has proved the contrary. But we cannot detect a cyclical succession in earthquakes, floods, and tempests without collecting notices of their occurrence. Hence we fail to see anything ridiculous in the author's habit of cutting out from the morning papers, and assorting all allusions to earthquakes, floods, general meteorology, and corn statistics. If he perseveres in such a course he will obtain the facts and their dates; he will be able to find, *e.g.*, whether such convulsions of Nature are more plentiful in years of maximum or of minimum sun-spots, or whether the two classes of phenomena have any apparent connection at all. It would, of course, be preferable if Mr. Swinton had a legion of agents distributed over the globe, each duly equipped with seismometer, rain-guage, anemometer, &c., and at once sending in to some central station the results of his observations. But in default of such an organisation, which it might exhaust the resources of a nation to maintain, the next best method is to avail himself of the public press.

The question whether the subject is in itself worth examina-

tion can scarcely be raised. If the sun-spots follow a demonstrable cycle with which the above-mentioned terrestrial phenomena coincide, the study of solar physics assumes the highest importance. By its means we may foresee whether any given year will be marked by many or by few earthquakes and cyclones, and we may in some respects modify our conduct accordingly.

In this sense—as far as prediction of the weather is concerned—Mr. Swinton's tables are at least an attempt at "an almanac of the Christian era." Even if, on further inquiry, the apparent connection between the sun-spot cycle and the earthquake cycle should not be capable of demonstration, the inquiry is not merely legitimate, but laudable. A negative result is vastly preferable to uncertainty. Hence we must pronounce the subject of Mr. Swinton's studies, the method he has embraced, and the purpose aimed at, all rational and worthy.

There are doubtless many cases where the theory of sun-spot cycles throws no definite light upon the course of the weather. More than a cycle has passed over since we have had a really genial, productive season. The maximum and minimum epochs have alike failed to bring us relief. From some instances we might conclude that the years immediately following the minimum should be the best. Thus 1867 was marked as a minimum. It was followed by 1868, the hottest and driest summer of recent times, with the finest wheat-crop both as to quantity and quality. The two following seasons, 1869 and 1870, though not equal to 1868, were yet fine and bountiful. In 1870 apples were so plentiful in many parts of England that they were thrown in despair to the pigs. But if we turn to the next minimum, 1878, we find a different tale. Its successor was "cruel '79"—perhaps the most disastrous year for the farmer on record.

Perhaps the greatest difficulty which has to be overcome, in establishing weather- and harvest-cycles, lies in the fact that different parts not only of the same hemisphere, but even of the same continent, may have seasons very different in character. Thus during the summer of 1882 cold and wet devastated Britain, France, Switzerland, Italy, and Germany. At the same time Hungary, Russia, and Turkey enjoyed a warm, dry season, and a bountiful harvest.

Hence it would seem that a plurality of causes must co-operate in determining the character of the weather. A further point to be considered is that the harvest is little affected by the total rainfall of the year or the annual mean temperature. It may be said to be, in England at least, directly as the temperature, and inversely as the rainfall of the summer months. Mr. Swinton makes the admission:—"It does not therefore appear that we must infer that all the great frosts of history recapitulated by Mr. Walford as happening between 401 and 1874 invariably closed in the cold years. Perhaps at the sun-spot periods we

have southerly winds with open winters in this island." No one will deny that the seeming caprice of the wind is a powerful factor in the character of a season. If the "polar current" sets in strongly in the first two weeks of January we can scarcely escape frost and snow. If the equatorial current maintains the upper hand at this critical epoch we have a mild winter. But by some curious circumstance, not as yet understood, southerly and south-westerly winds in summer are not always mild. In 1879 the worst fits of summer cold were brought by south-westerly winds.

Mr. Swinton's researches on the periodicity observed in the visits of certain species of insects have repeatedly attracted our notice. In the work before us he foretells, or at least indicates as probable, that in the coming year the larger and finer Sphinges, such as *C. Nerii*, *S. Convolvuli*, &c., may visit our shores along with certain rare butterflies, such as *V. Antiopa*, *Pieris Daplidice*, *Colias Edusa* and *Hyale*, &c. It is interesting to notice that during the past summer specimens of the two latter insects appeared on our southern coasts, possibly heralding a swarm to arrive in the next season.

We should recommend Mr. Swinton to concentrate his attention especially upon cyclical phenomena in the appearance of animal species. It is an interesting fact that for the last two seasons herring and cod have been exceptionally scarce and poor on the Norwegian coasts. This winter herrings have appeared in great force at the Lofotens, and it is hoped that the cod will follow their lead.

Natural Philosophy for General Readers and Young Persons. Translated and edited from Ganot's "Cours Elémentaire de Physique," by E. Atkinson, Ph.D., F.C.S. Fifth Edition. London: Longmans and Co.

This book is sometimes confounded with a larger work by the same author and editor. The volume before us is, however, not a mere abridgment of Ganot's "Eléments de Physique," but a version of his "Cours Elémentaire de Physique." It is specially intended for the general reader who, in these days, cannot well afford to remain devoid of an accurate, even though sketchy, knowledge of physics. Its claims upon the attention of the student are shown by the statement that it may be approximately taken to represent the amount of knowledge required for the matriculation examination of the London University. It is also adapted for the upper classes in schools. Its suitability for these purposes may be fairly judged by the fact that a fifth edition has

been called for. The editor has made such additions as the course of scientific discovery demands, but without otherwise modifying the character of the work.

It may perhaps seem presumptuous to criticise any statement in a work of such general accuracy, and so justly approved of by teachers of physics. The following passage strikes us, however, as being open to exception:—"The action of a *noise* (as contradistinguished from *sound*) upon the ear has been compared to that of a flickering light upon the eye; both are painful, in consequence of the sudden and abrupt changes which they produce in their respective nerves." Now it seems to us that musical sounds are more distressing to a person who has any engagement other than listening to them than are most noises. We speedily get accustomed to the roll of street-traffic, to the rushing of a river, or the sough of the wind in the trees; but who can get inured to the tolling of church-bells, or to the strains of a piano or an American organ in the next house?

It may perhaps be asked why Dr. Atkinson retains the term "Natural Philosophy," in place of its more precise modern equivalent Physics?

How to Arrest Infectious Diseases. By EDGAR BARNES, M.D. London: J. and A. Churchill.

IT is in these days permissible to seek for the reduction—and, if possible, for the extinction—of some diseases, whilst others appear to be like water companies, "vested interests" sacred in the eyes of John Bull, and not to be restricted or interfered with. Fevers, smallpox, cholera, &c., have monopolised the title "preventible diseases," and the attention of sanitary reformers.

From this somewhat limited point of view the little book before us is a clear, intelligible compilation. It aims at serving the general practitioner as reminder of "minute details, familiar enough but apt to evade the memory just when they are wanted." As such the work is of considerable value; but it is also intended to be placed in the hands of any intelligent non-medical man as a guide to him in protecting his family from the ravages of these diseases. It is undeniably well calculated to serve both these purposes.

The author opens his subject by explaining the terms *infection* and *disinfection*. On the exact nature of infection he does not find it necessary to speculate, and uses the expression "disease-germs" merely in a provisional sense, without pledging himself to any theory as to their constitution. He describes the ordinary invisible dust suspended in the air, and enumerates its constituents as actually determined by microscopic and micro-chemical

research, italicising those calculated to be the causes, or at least the bearers of disease.

In the second chapter we find an account of the precautions to be taken during the progress of infectious disease. In boarding-schools he recommends, on the attack of fever, &c., not an immediate breaking up, and the consequent possible dissemination of the disease, but to divide, if practicable, the sufferers from the healthy in a separate building.

The author seems to favour aërial disinfectants. He admits that " by their use you cannot make an infected atmosphere pure and safe without rendering it destructive to the sufferer as well." Yet he holds that an atmosphere impregnated as far as practicable, *e.g.*, with chlorine, is unfavourable to the activity of disease-germs. He protests, most justly, against the selfish—and in fact criminal—practice of removing convalescents *whilst still infectious* to the sea-side. He shows that every such case may infect a couple of cabs and a railway-carriage, and the lodgings which the convalescent has occupied are rendered unsafe—perhaps even deadly—to succeeding occupants. This, indeed, shows some of the mysterious channels through which infection may reach the inmates of houses in which all sanitary precautions are duly observed.

We come next to the instructions for the management of special diseases.

The statistics of the London Smallpox Hospital show some very curious results. Whilst 35 per cent of the deaths were those of unvaccinated persons, and 23·57 of persons said to have been vaccinated, but having no visible cicatrix, 19 per cent *had previously had smallpox*, whilst only 14·93 per cent had been vaccinated. Hence it would appear that vaccination is a more efficient safeguard even than a former attack of smallpox! How will the Anti-Vaccinationists explain these figures?

At the same time another statistical table on the opposite page requires a little explanation. We read there:—" Vaccination optional, 1847—53, annual death-rate from smallpox per million 305." But optional vaccination had been practised for many years previous to 1847. What was the death-rate then?

Among disinfectants we find mention of ozone,—a doubtful agent to be dealt with by the general public.

Under the head of Legislation the author pleads for the compulsatory notification of disease. He would, however, throw the *onus* not on the medical attendant, but on the head of the household. Such a measure would be exceedingly unpopular, and we doubt whether the benefits derived by the community would be at all commensurate with the obvious hardships which it would involve.

Dr. Barnes has carried out his plan as completely as was possible within the scope of some eighty small pages, and his treatise will be a boon to no small part of the community.

On some Improved Laboratory Appliances for conducting many Chemical Operations at the same time, and hastening the Completion of several of them. By ROBERT GALLOWAY, M.R.I.A., F.C.S., and F. J. O'FARREL, M.R.I.A., F.C.S. (Reprinted from the "Philosophical Magazine."

THE authors of this memoir lay down the proposition that "it requires a greater expenditure of time and labour to arrive at results in Chemistry than it requires to attain like ends in any other of the inductive sciences." Without absolutely accepting this view, we may freely admit that the time and labour so expended are exceedingly great, and that any improvement tending towards this end must render the task of research lighter and easier. We are told, as an instance of what such inventions may practically signify, that if Liebig's apparatus for quantitative organic analysis had been devised before Chevreul began his examination into the constitution of fats, he would have been enabled to save seven of the fourteen years which he devoted to this investigation. Seven years of the working time of a man like Chevreul are no trifle.

Messrs. Galloway and O'Farrel remark that "at the present time a great deal of labour is involved, and time wasted, by having to set up in a laboratory, where a variety of work is going on, so many distinct pieces of apparatus, each requiring to be started separately. For obtaining the indispensable distilled water, a special still and heating apparatus is generally set apart for the purpose. Distillation under diminished pressure is another distinct, and frequently troublesome, operation. If a filter-pump is employed to hasten filtration, the pump is solely devoted to that purpose. Then there are the open and closed water-baths, each distinct and requiring a separate heating-apparatus; and for heating and drying substances above 100° C. the methods are most inconvenient. But of all the slow methods, that of evaporating by means of the ordinary air-pump and absorbing the water as it evaporates by means of sulphuric acid is, we think, the slowest. The appliances that are in use generally for forcing steam, air, or gases over substances, are, to say the least, inconvenient.

"By the aid of a small general air-pump connected to a little stationary engine, and ordinary or superheated steam, all these operations can be carried on at the same time with these appliances excepting the one last described: for this operation there is required, in addition to the air- or suction-pump, a compression-pump in connexion with the engine.

"In carrying out some researches recently we found great convenience and saving of labour and time in employing a general air-pump. This has led us to devise appliances for the

extension of our plan to a larger number of chemical operations, which we will now describe, as we think the arrangement will be found very useful not only in educational laboratories, but also in pharmaceutical laboratories, especially in the preparation of delicate organic compounds."

We cannot give a description of the authors' appliances without the accompanying illustrations, but we feel convinced that they will be widely useful in the laboratories of colleges, and in those of manufacturing establishments where large numbers of determinations are always in progress, and where economy of time is a matter of supreme moment.

Journal of the Royal Microscopical Society. Containing its Transactions and Proceedings, and a Summary of Current Researches relating to Zoology and Botany (principally Invertebrata and Cryptogamia), Microscopy, &c. Edited by Frank Crisp, LL.B., B.A. Series 2, Vol. III., 1883, pp. 972. Published for the Society. London and Edinburgh: Williams and Norgate.

The editor of this Journal and his able staff of assistants have again been unsparing in their efforts to place before English readers a summary of everything of importance relating to the microscope and those branches of Science needing magnifying power for their investigation, which has transpired during the past year both at home and abroad.

The papers forming the "Transactions" of the Society are only seventeen in number, but all of considerable value: the discussions following their reading have been reproduced from the short-hand writer's notes, and from the important matter elicited from those familiar with the subjects of the various papers form a valuable supplement to the more formal Transactions.

The fact of the original papers being so few in number is no fault of the Royal Microscopical Society, but rather the natural result of its work during the past forty-four years of its existence. In 1828, only twelve years before the formation of the Society, there were only four achromatic microscopes in London, and during the earlier years of its existence microscopes and workers were still few in number; and papers on microscopical subjects were rarely or never admitted to discussion at the older societies. At one of the early meetings of the Quekett Microscopical Club the late Dr. Lankester (then president) stated that he recollected the time, not very far back, when being known to be engaged in the study of minute anatomy would seriously prejudice a medical student's examination. The Microscopical Society and its earnest

members, however, worked steadily on; the late John Quekett laid the foundations of Histology as a science, and the result has been that at the present time the microscope is a necessary tool in most branches of scientific enquiry, and the papers which could only get a hearing at the Microscopical Society are now eagerly sought for, and find a place in the Transactions of numerous other bodies.

As usual, translations from foreign sources have been given at considerable length. An important paper on "Practical Processes in Vegetable Histology" occupies no less than twenty-two pages, and gives valuable information on a subject on which but little has as yet been published in the English language,

The summary is divided into three sections—Zoology, Botany, and Microscopy. The first two are subdivided into several sections, the latter into two; the first treating of new and improved instruments, the latter on various processes of collecting, mounting, and examining objects.

The current literature of the microscope is tabulated,—a matter of great importance, saving much weary searching among the ever-growing mass of modern periodicals.

As to rendering the large volume of the Journal accessible, no trouble has been spared; the table of contents and the alphabetical index are both of ample proportions and well arranged, a matter very often neglected, and detracting much from the value of otherwise good books of reference.

The whole book reflects the usual liberal spirit of the Royal Microscopical Society, always ready, as are most of their Fellows individually, to help other workers. No less than eighty-four societies, home and foreign, instituted for kindred objects, have been affiliated through the *ex officio* fellowship conferred upon their presidents; these, with the numerous eminent scientists who have received the compliment of honorary fellowship, extend the influence of the Royal Microscopical Society throughout the civilised world.

Longman's Magazine. No. XIV. December, 1883. London: Longmans and Co.

We may notice in this issue a paper by the Rev. J. G. Wood, entitled "The Mole at Home, and containing a very fair account of the anatomy, as well as of the habits, of the "little gentleman in black velvet,"—once enthusiastically toasted at Jacobite meetings. The following passage, however, is scarcely happy:—"The instinct coincides with the structure, so that we never see a mole trying to fly in the air, a bat trying to dig a burrow

in the ground, or a whale attempting to walk on land." Would it not have been more satisfactory to have read "the habits follow from the structure"?

The fact that moles can swim is by no means generally known. The author quotes a letter from a Mr. Clark, who, whilst justly protesting against the extermination of the rook and the mole, pleads for the sparrow also. If he would shoot and open every sparrow he comes across, he would find that during the greater part of the year these little pests feed not upon destructive insects, but upon grain and fruits. This, joined to the war which they wage against the harmless and useful swallow and martin, should surely settle their doom.

"The Modern Nebuchadnezzar," by A. H. A. Hamilton, is certainly a psychological curiosity. The author tells us that he met in Italy with a self-exiled Englishman who, according to his own account, had as a punishment for his vices, especially cruelty, been transformed into a horse, though retaining a clear recollection of what he had been. After seven years he was suddenly restored to human shape. He expresses the opinion that "experiences similar to his own have been the lot of many human beings." It need scarcely be said that the alleged phenomenon bears no resemblance to the "re-incarnations" of which the Occultists tell us. Nor can the hero of the story be fairly likened to Nebuchadnezzar, who is not stated to have lost the human form during his alienation. If such transformations are not uncommon the world is evidently a theatre of anarchy.

This fevered tale is not free from the poison which writers of fiction, on the principle of the blind leading the blind, so commonly instil into their more ignorant readers. The man-horse is put into the hands of a veterinary surgeon, who, he says, "lanced me and blistered me, and almost vivisected me." Here it is falsely insinuated that the pain inflicted upon animals under physiological examination is something altogether exceptional in its intensity. Even the Bestiarian leaders know better than this, though it suits their purpose to hoodwink the public.

Among the strange utterances to be found in this story is the assertion that "many persons have been placed in a position similar to mine, but the power of speech has been allowed to them only in a very few instances. Some of these are recorded in the early history of Rome, but the case of Balaam's ass is perhaps the best authenticated."

No. XV. January, 1884.

In a somewhat flippant article on the "Decay of the British Ghost" a Mr. F. Anstey, though evidently acquainted with the Psychical Research Society and its doings, and presumably not ignorant of the existence of Spiritualism, Occultism, and Theosophy, strangely misinterprets the tendencies of the time. The

British ghost is evidently reviving! Would that certain other features of bygone days, such as the absence of worry and a fair share of national prosperity, would follow his example.

The "Ancestry of Birds" is a fair account of the development of birds from reptiles, though containing little that is novel in fact or original in generalisation. It might, indeed, be asked whether the reptiles are "at present a small and dying race"?

The "Clerk's Tale" is an instance of life preserved by a hallucination or an apparition, and contains due reference to the Psychical Research Society.

The Mason College Magazine. Vol. I., No. 9. December, 1883. Birmingham: Cornish Bros.

We regret to find that the conductors of this interesting little magazine have found it advisable to reduce its yearly issues from nine to six.

Prof. Poynting's Address delivered at the Mason College takes up a note which we hear everywhere with satisfaction, but which, so far, leads to nothing. He justly likens the English system of teaching and examining "to the charging of secondary batteries which only give back what was put into them, with some inevitable loss of leakage. He thinks that in a true University training students should learn how to arrive at results by their own methods. This is what every man of sense, unless interested in the present system, thinks and says. But we do not rise to the emergency, and once for all tear the examination system to pieces and trample it under foot. We allow it to go on, wasting public money and stereotyping our youth into general incapacity.

Some remarks on "Duty" are, with the exception of one sentence of three words, very appropriate.

"Chemistry in the West Indies" is interesting, and might easily be rendered more so. It is to be hoped that the author will continue his contributions.

In a discussion on "Popular Narcotics" a medium view was adopted. They were pronounced not necessities, but at the same time not dangerous poisons.

Another interesting debate is reported, on the proposition "That it is desirable to agitate against the tyranny of fashion." The majority of votes was in the affirmative, though one of the speakers committed himself to the sentiment that it is "well to agitate against everything!"

The Science Monthly, Illustrated. Vol. I., No. 3, January, 1884. London: D. Bogue and E. W. Allen.

It is easy to see why this Journal has been sent to us. The Editor is not gratified at our comments on an utterance in his "Table Talk" for November anent the Anti-Vivisection hubbub, and he propounds it as a "riddle" to find the occasion for our remarks. This riddle may be easily solved by a reference to his own words:—"I hope (*sic*) the *Champion* may be able to compass this feat (*i.e.*, to prove that Vivisection is wrong): but one cannot help thinking that the *Zoophilist* takes the best ground after all, in contending that the practice is reprehensible because it is possibly useless and certainly cruel." In thus writing our contemporary, so to speak, formally hoists the Bestiarian flag.

Apparently in consequence of his expression of sympathy two works have been sent him from the enemy's camp for review, and they are noticed—one of them favourably—in the issue before us. We note, further, an article on "Experimental Physiology," the spirit of which is certainly not hostile to the agitating fanatics. The question is put, among others, "If Experimental Physiology be a legitimate branch of human inquiry, what ground is there for limiting its application to the brute creation? Might we not equally well ask, "If killing animals for food be legitimate, what ground is there for limiting its application to the brute creation?" Similar queries might be raised concerning compulsatory labour, castration, and other "cruelties" which man inflicts upon the brute creation. Until the Bestiarians are prepared to show that the infliction of pain and death upon animals is less legitimate in pursuit of knowledge than in pursuit of "sport," convenience, gain, luxury, &c., we hold that they have no logical right to say another word. But this task they never even attempt.

Woods and Forests, Landscape, Covert, Park, Arboretum, and Nursery. A Weekly Illustrated Journal of Forestry, Ornamental Planting, and Estate Management. No. 2.

We are, both by heredity and by early association, worshippers of trees. We honour those who plant and protect them, and we loathe those who deface or needlessly destroy them. We need scarcely, therefore, say that a paper like the one before us, which recommends and enforces tree-planting, and gives practical instructions as to how it may be best effected, has our hearty good wishes.

CORRESPONDENCE.

. The Editor does not hold himself responsible for statements of facts or opinions expressedi n Correspondence, or in Articles bearing the signature of their respective authors.

PROFESSOR TYNDALL AND MATERIALISM.

To the Editor of the Journal of Science.

SIR,—Until very lately Professor Tyndall has been universally held to be a Materialist. As an instance of the manner in which he has been spoken of I take a few lines which you, in your October issue (p. 614), quoted from a Lecture delivered by Dr. Usher at Ballaarat. The lecturer is reported as saying—"It is incomprehensible to me how men . . . nevertheless reject a Designer, as everyone must acknowledge who reads Tyndall's Belfast Address between the lines—rank Atheism, thinly veiled throughout." Yet an American journal quotes him as saying—"If asked whether Science has solved, or is in our day likely to solve, the problem of the universe, I must shake my head in doubt. Behind, above, and around us, the real mystery of the universe lies unsolved, and, as far as we are concerned, is incapable of solution. The problem of the connection of the body and the soul is as insoluble in its modern form as it was in the pre-scientific ages."

Here, therefore, the existence of a soul—a distinct entity requiring to be connected with the body—is admitted. It may further be said that its immateriality is conceded. Why else should its connection with the body be recognised as an especially difficult problem?

But, if the word "soul" is here to be taken in its ordinary sense,—and Prof. Tyndall makes no stipulation to the contrary,—how are we to "discern in Matter the promise and the potency of all terrestrial Life?" How, again, are we all, "like streaks of morning cloud," to "melt into the infinite azure of the past?"

The quotation proceeds:—"There ought to be a clear distinction between Science in the state of hypothesis and Science in the state of fact, and, inasmuch, as it is still in its hypothetical stage, the ban of exclusion ought to fall upon the theory of Evolution."

Yet in the Belfast Address Prof. Tyndall pleads ably and earnestly for this very theory of Evolution, and even speaks of "the

doctrine of the survival of the fittest, which in our day, on the *basis of positive knowledge*, has been raised to such extraordinary significance."

What, then, is Professor Tyndall,—Materialist or Spiritualist, Monist or Dualist? The trumpet or the fog-horn gives an uncertain sound.—I am, &c.,

VARRO.

OBSERVATIONS IN NATURAL HISTORY.

To the Editor of the Journal of Science.

Markings of the Lion.—Ten years ago I saw lion cubs, at Wombwell's show, with leopard spots visible by side light, like "shot-colors."

Squirrels.—Grantley Berkeley found the squirrel an enemy to pheasants and partridges; and although it is, as you say, "a tree rat," it does not confine itself to trees. In winter I found one in a hedge, far from trees, above 12 feet high; and, near Barmouth, I saw a white-tailed squirrel leap from stone to stone along a brook with greater activity than a rat, and I suspect he was looking for *fish*; he was so eager that, as I stood motionless, he passed almost under my fishing-rod. The white-tailed squirrel is rare, and I never saw another.

Fireflies.—Leigh Hunt, in his "Autobiography," speaks of the brilliance of fireflies in Italy, and says that they are not noticed by Greek or Latin writers; and he thinks they are first mentioned by Dante, and that they may have been brought from America. Is this correct?

Hybernation.—Must not the mammoth have hybernated?

HUGH BROWNE.

Nottingham, January 4, 1884.

TAPE-WORMS AND HERMAPHRODITES.

To the Editor of the Journal of Science.

SIR,—Professor Huxley, in his Letters to Working Men (Hardwicke, 1863) "On our Knowledge of the Causes of the Phenomena

of Organic Nature," says, "The tape-worm exists in the human intestines, so that the fewer there are of men the fewer there will be of tape-worms, other things being alike. It is a humiliating reflection, perhaps, that we may be classed as direct helpers to the tape-worm; but the fact is so. We can all see that if there were no men there would be no tape-worms" (p. 122). Whether or not it is received as a biological fact, that the tape-worm is alone incidental to man, I do not know. Clearly the inference to be drawn from the above quotation is, that such is the fact. In opposition to this opinion I have an observation of my own to offer, *viz.*, that the tape-worm is present with other animals besides man. I had a bull terrier which, when about nine months old, was sadly troubled with worms, usually maggot-like creatures. On three several occasions, under my notice, the dog voided tape-worm from 6 inches to a foot in length.

On another question in Physiology there appears to be a fog—*viz.*, as to the creatures which are hermaphrodite. The snail, I believe, is instanced, but not the common earth-worm. This is an hermaphrodite; each worm impregnates the other by a double process common with both. This fact can be ascertained by any person interested in the subject in the evenings of August. The worms may be seen lying heads towards tails (I have seen them in hundreds); on being separated the distinct organs may be seen. Whether this fact has been observed by others I do not know; I find no notice of it in books. I do not suppose it is possible that my dog and my worms are isolated facts.

Whether the facts are new or not I have thought them worth recording, and hence the reason for my troubling you.—I am, &c.,

S. Billing.

[There are at least three species of tape-worm which occur in the dog,—*Tænia serrata*, *T. echinococcus*, and *T. marginata*. These are distinct from the species inhabiting man. The entire order to which the earth-worm belongs is hermaphroditic.—Ed. J. S.]

NOTES.

The following singular advertisement appears in the "Deutsch-Kroner Zeitung" of December 11th:—"Magpies shot between December 24th and January 6th are used for a remedy against epilepsy. The undersigned, with whom this medicine is prepared, will be greatly obliged to everyone who will send him at that time as many magpies as possible, provided that they have been shot, and not killed by poison or caught in traps.—Castle Tütz, Dec. 5, 1883.—Signed, Theodor, Count Stolberg.

[We feel strongly tempted to consider this advertisement as due to a survival, or rather a recrudescence, of superstition.]

Prof. Edlund controverts the generally-received statement that a vacuum—or highly rarefied air—is a non-conductor of electricity. He maintains that the obstacle to the passage of the current lies in the resistance of the electrodes, and disappears entirely with their suppression.

According to Dr. S. B. Higgins ("American Naturalist") the copperhead snake (*Ancistrodon contortrix*) always strikes at the ankles of its enemy, in contradistinction to the Crotalidæ, which aim higher.

Dr. Hyades, of the late French Expedition to Cape Horn, reports that rabies are unknown among the dogs of Tierra del Fuego.

M. Rochefontaine ("Comptes Rendus") announces that cholera, smallpox, typhoid fever, and anthrax are by no means uncommon among the coppersmiths of Villedieu.

According to Dr. Stone the human body is a far better conductor of electricity when suffering from paralysis than when in a state of health.

A fungus (*Aspergillus glaucus*) flourishes well in the solutions of the alkaloids, such as morphine and atropine.

Dr. Landwehr ("Zeitschrift Phys. Chemie") has obtained a true gum from mucine and metalbumen. It is capable of fermentation, and by boiling with dilute acid is converted into a sugar which reduces copper oxide.

The Society for Psychic Research proposes a so-called "ghost-census." The Society is seeking for cases "where some marked event happening to a person at a distance has coincided with the apparent perception of that person's presence or with a dream of him."

Trout-breeding, as it appears, is fairly successful in New Zealand. Mr. Pillans, of Otago, has now in his nursery tanks about 6000 yearlings and 250 two-year old fish, all thriving.

The "poor humanist" ought to feel gratified with the Peerage offered to the Laureate, a man unfriendly to Science and of Bestiarian propensities. During the lifetime of the present generation four Peerages have been awarded to "letters,"—to Science none!

According to the "Electrical Review" Mr. G. G. Rockwood has succeeded in photographing the waves of sound. What say the "Substantialists"?

According to Sir R. W. Rawson the measurements of the Anthropometric Committee show that from the top of the social scale to the bottom there is a gradual descent in stature, chest-girth, weight, and all the elements of strength.

A submarine observatory is, according to the "Petit Niçois," about to be constructed at Nice; the submarine flora and fauna illuminated, if necessary, by powerful electric lamps.

Prof. Von Fleischl ("Chem. Physik. Gesell. zu Wien") concludes that the retinal rods supplied by one and the same nerve-fibre do not form an anatomical group, but stand intermixed with rods supplied by other nerve-fibres.

Mr. W. K. Brooks ("American Naturalist") argues that the germ-cell is the persistent and the sperm-cell the progressive element in the formation of a new being.

M. Auguste Charpentier ("Comptes Rendus"), in course of researches on the perception of differences of illumination, shows that the *differential fraction* (the excess of the illumination of the object over and above that of the back-ground) is by no means constant.

M. V. Jodin ("Comptes Rendus") has succeeded in cultivating plants in solutions of putrescent organic matter.

According to the "Medical Press" the water-supply of Newcastle is supplemented in dry weather by fluid pumped up from the Tyne, below the point where the sewage of Hexham is discharged into the river.

R. Billwiller, from anemometrical observations conducted simultaneously on the Santis, 2467 metres in height, and in the valley, finds that calms are very rarely to be met with except on the surface of the earth.

"Science" recommends that authors who re-publish, in a separate form, memoirs which first appeared in the Transactions of Societies, &c., should be careful to retain the paging of the original.

M. J. Thouclet has studied experimentally the velocity of currents of air or water capable of holding mineral particles in suspension.

According to the "Comptes Rendus" the extraordinary phenomena accompanying sunset and sunrise, in November and December last, have been observed at Lyon, Rambouillet, Valencia, and Christiania.

Dr. Carter Moffat, in a Lecture delivered recently at Glasgow, maintained that the presence of hydrogen peroxide in the air and dew of Italy had some connection with the beauty of the Italian vocal tone.

We regret to find that the election of an Assessor to the Council of St. Andrew's University has been conducted on political lines.

M. P. Fischer ("Comptes Rendus") shows that the abysmal fauna of the intertropical Atlantic, though containing many boreal forms, is not exclusively composed of immigrants from the Arctic Seas. The limits in depth of the boreal species increase as we approach the Equator. Thus *Malletia obtusa*, found at 200 fathoms near Norway, occurs at 3200 at the Senegal.

Mr. R. S. Tarr ("Science") gives an account of a tract of "singing sand" which forms a long narrow strip on the coast at Monomoy Point, Massachusetts.

Prof. A. Winchell denies that the period of the inner satellite of Mars furnishes any objection to the nebular hypothesis.

"Science" quotes from the "Transactions of the New Jersey Microscopical Society" (Nov. 19th, 1883) an account of a full-grown dipterous larva (*Sarcophaga carnaria*) taken from the inner ear of a man at Paterson, New Jersey, August 30th, 1883. The author, Dr. S. Lockwood, referred to papers which he had read before the Society in 1880 and 1881, describing larvæ of *S. carnaria* and *Anthomyia canicularis* passed by a man in large numbers. Dr. A. V. N. Baldwin had recently found a cluster of grubs, hard packed, in the external ear of a man in the Bellevue Hospital.

The "New York Sanitary Engineer," as quoted by the "Medical Press and Circular," reproduces the ancient joke of a reporter who mixed up his notes of a meeting on the conversion of the Jews with those of a discussion on the sewage question.

Rev. Dr. McCook has read a paper, before the Philadelphia Academy of Natural Science, on the weaving habits of *Psocus sexpunctatus*. The Psocidæ, a neuropterous group, are the only known insects which spin when in the mature state.

It is said ("Science") that the powder of the Kola nut renders foul water drinkable and harmless. It thus plays in Africa the same part as do the seeds of *Strychnos potatorum* in India.

M. Dieulafait ("Comptes Rendus"), after a prolonged investigation, concludes that the gypsums and ophites are independent in their origin.

The "Zoologischer Garten" records the birth of a mandrill at Hamburg. The facial wrinkles and the brilliant colours of the face were not well marked.

M. J. Chatin ("Comptes Rendus") has been studying a Nematode which is parasitical not in any animal, but in the onion. The species in question belongs to the genus *Tylenchus*.

Says "Light"—"We may depend upon it that when Science and Theology are both sufficiently awake to see a common enemy in Spiritualism, there will be lively times."

A correspondent informs us that a dead owl was recently found near Emsworth with the tail of a rat protruding from its beak. Either the owl had been choked in attempting to swallow the rat (?) or the latter when seized had forced itself into the bird's throat in trying to escape.

Bishop Butler says that communities may go mad as well as individuals. Experience says the same.

The "Geological Magazine" gives a very able notice of "The Connection of the Animal World in Geological Times," by Prof. Gaudry, one of the latest and most important converts from Cuvierism to Evolution.

The late Electrical Exhibition in Vienna has not proved successful from a commercial point of view. The deficiency is said to amount to £6000.

"Science" gives an able and appreciative survey of the life and work of the late illustrious American entomologist, John Lawrence Leconte.

Among the fishes most commonly eaten the cod is poorest in total solid matter, in albuminous compounds, and in fat.

"Les Mondes says of a recent French author, "He is neither a German nor an Englishman, in an age quite infected with Germanism and Britonism. He is himself, with the qualities of the French mind."

M. Delbœuf, a "Dissenting Positivist," complains that "accredited Science does not scruple to constitute ponderable matter of imponderable atoms, polarised matter of non-polarised atoms, variable matter of invariable elements."

The temperature produced by the release of liquefied oxygen is given by M. Wroblewski ("Comptes Rendus") as approximately -186° C.

Certain compounds isolated by M. Pouchet from animal excreta and from putrescent matter, and described in a communication to the Academy of Sciences, occasion in frogs paralysis, with cessation of the reflex movements. The heart is finally arrested in systole.

The Rev. W. H. Dallinger, F.R.S., has been nominated to the chair of the Royal Microscopical Society. The president elect has been distinguished for his researches in conjunction with Dr. J. J. Drysdale, on the life-history of monads, an investigation of the most laborious nature: in some instances the two observers relieved each other at the microscope for a long period, until the observations were completed. One of the most important results of their researches was the discovery of the comparatively high temperatures* which the germs of the most minute Infusoria were capable of surviving, amounting almost to indestructibility, and giving the finishing blow to the doctrine of heterogenesis.

Prof. R. Owen, on retiring from his post as Keeper of the Natural History Department of the British Museum, has received the rank of C.B. Surely a trifling honour, if we consider the exalted merits of the veteran *savant*, and compare him with certain men upon whom it has been formerly conferred!

"Les Mondes" announces the formation of an "International Society of Electricians," the officials and council of which appear, however, to be all Frenchmen.

It is said that Prof. Huxley, P.R.S., will receive the offer of a baronetcy.

The epidemic of trichiniasis at Emersleben, and some neighbouring villages, extended to upwards of 370 persons, of whom 51 died. All the sufferers had eaten "hack fleisch," *i.e.*, pork chopped up fine, and consumed perfectly raw!

M. A. Cornu ("Comptes Rendus") records a *white* rainbow, seen at Courtenay, on the morning of November 28th.

M. Ch. Trepied, in a communication to the Academy of Sciences, states that the spectrum of the comet Pons-Brooks agrees in its visible portion with that of the flame of alcohol.

Mr. "Stuart Cumberland" has been performing in Edinburgh under the combined auspices of Law, Physic, and Divinity.

* *Tetramitus rostrata* could resist a temperature of 250° F. (121° C.); *Dallingeria Drysdali*, 220°; *Cercomonas typica*, 260°; and *Heteromita rostrata* and *H. uncinata* passed unscathed through a temperature of no less than 300° F. (148° C.), which represents the highest limit that has yet been obtained.

According to Dr. Hahn ("Comptes Rendus") the Yakanas, a tribe inhabiting the neighbourhood of Murray Straits and of Beagle Channel, celebrate a yearly festival commemorative of the revolt of the men against the women, who had previously held the chief authority in the family, and who possessed the secrets of sorcery.

The presence of the *Phylloxera* in the vineyards of Victoria is unfortuately a demonstrated fact. A Sub-committee of the Entomological Society have made a minute examination of roots of vines sent over for this purpose by the Victorian Minister of Agriculture, and have found upon them numerous specimens of the insect in its "under-ground" stage.

The interesting collection of Lepidoptera formed by the late Prof. Zeller, of Stettin, has become the property of Lord Walsingham.

We learn from a contemporary that a graduate in medicine being asked "What is Semeiology?" answered "A description of the Spermatozoa."

According to the Astronomer Royal ("Monthly Notices of the Royal Astronomical Society") the green band of the spectrum of the Pons-Brookes comet does not coincide with the green band of the alcohol spectrum, but lies far to the blue of it.

The Anthropometric Committee of the British Association report that Fellows of the Royal Society are more than 2 inches above the average stature. (We wish a separate measurement could have been made of that select body of the Fellows who communicate papers to the "Transactions" and the "Proceedings."

M. Marcel Deprez contends that electricity is not one of the forms of energy, but is merely its vehicle.

Dr. W. Jones ("Science") records that a spider remained shut up in a paper box for 204 days without any kind of food. She did not appear feeble or emaciated until within three days of her death.

Mr. W. H. Hudleston, F.G.S. ("Mineralogical Magazine") thinks it possible that the diamonds in South Africa are the result of reactions which have taken place between the hydrocarbons of the shales and the hydrous magnesian silicate, under peculiar conditions of temperature and water-gas pressure.

In the advertisement list of an eminent American firm of educational publishers we find 30 books on Latin, 19 on Greek, 11 on Music, and 3 on Science,—to wit, a treatise on vibratory motion and sound, an elementary manual of Physics, and a set of questions on Physics. Do these figures show the relative position which the heads of colleges and schools allot to Science?

" Science " remarks that " Science must be almost as much popularised to be made accessible to all scientific readers as to be readable by the educated public who were never in a laboratory."

The skeleton of an unusually large mastodon (" Kansas Review of Science ") is said to have been found near Woodstock, in Canada. The lower jaw is 30 inches long, and must have weighed upwards of 150 lbs.

Dr. A. Gœtte considers the cause of death in the simplest polyplastides to be " propagation by germs capable of development."

A. Burgerstein (" Deutsche Botan. Gesellschaft ") has observed that the petals of the Compositæ are capable of absorbing water, the lower surface more readily than the upper.

" Science " gives an interesting account of the marine laboratory in connection with the Johns Hopkins University.

The " Popular Science Monthly," in an otherwise able article against the predominance of classical studies in education, says, " A despotic paternal Government has Church-and-State reasons for maintaing a dead-language culture as a national policy."

Mr. A. G. Boardman, in the same paper, gives facts supporting the view that Dipterous insects are carriers of disease.

Herr Westermaier (" Berichte Deutsch. Botan. Gesellschaft ") traces the ascent of water in plants mainly to endosmotic action.

Professor Owen, in a recent work, maintains that the dorsal aspect of a caterpillar or a crab really corresponds with the ventral aspect of a vertebrate animal. The pineal and pituitary bodies are the residue of the deutostome or invertebrate mouth.

Professor Helmholtz calculates that the solar system has been in existence for 500 million years,—a more liberal allowance than that of certain English physicists.

Professor Heer maintained that the true vine is an archiæval inhabitant of Europe.

The first atmospheric wave caused by the Sunda eruption reached Berlin ten hours after the event; sixteen hours later came a second wave, *viâ* America; and thirty-seven hours afterwards a third, by the direct way. Minute and unusual fluctuations of the barometer were still traced until September 4th.

The " Banner of Israel " announces the discovery of certain remains of Noah's ark.

Dulau 7/.
2.2.84.

Twenty-first Year of Publication.

THE

JOURNAL OF SCIENCE

AND ANNALS OF

Astronomy, Biology, Geology, Industrial Arts, Manufactures, and Technology.

MONTHLY, FORMERLY "THE QUARTERLY JOURNAL OF SCIENCE."

PRICE, ONE SHILLING AND SIXPENCE.

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THE

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ASTRONOMY, BIOLOGY, GEOLOGY, INDUSTRIAL ARTS, MANUFACTURES, AND TECHNOLOGY.

(MONTHLY, FORMERLY "THE QUARTERLY JOURNAL OF SCIENCE.")

POST TENEBRAS LUX

Vol. VI. (Third Series)
No. CXXIII.

MARCH 1884.

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LONDON:

3, HORSE-SHOE COURT, LUDGATE HILL.

Where Communications for the Editor and Books for Review may be addressed.

PRICE ONE SHILLING AND SIXPENCE.

THE

JOURNAL OF SCIENCE.

MARCH, 1884.

I. THE PHYSICAL AND CHEMICAL LIMITS TO POPULATION.

IN a recent work* of merit, and which derives additional importance from the auspices under which its contents were first put forward, we noticed a very strange quotation. The author gives as "very suggestive" the following extract from the "Progress and Poverty" of Mr. Henry George:—"That the earth could maintain a thousand billions of people as easily as a thousand millions is a necessary deduction from the manifest truth that, at least as far as our agency is concerned, matter is eternal and force (energy) must for ever continue to act."

It is, of course, under common circumstances, no part of our duty to discuss the utterances of politico-social "reformers" and ochlogogues. When such utterances, however, betray a misconception or a misapplication of scientific truths, we feel bound to put in our protest. Never was there a more fitting season for such a protest than at present. We are perplexed—almost pained—to find out by what process of thought Mr. George has come to regard the indestructibility of matter and the conservation of energy in the light which he manifestly does.

If both matter and energy were to come to a sudden end this day next year, or this day ten years, it is plain that up to that date the scope for animal—and in particular for human—existence would remain precisely what it is. If,

* Energy in Nature. By W. LANT CARPENTER, B.Sc.

instead of such instantaneous extinction, a very slow decrease were to set in, the possibility of life might not be appreciably lessened, say, for a century to come. So little connection has the persistence of energy with the sum total of people which this earth can support at any one time! But the *quantity* of such energy, especially in the forms of light and heat, is a matter of much greater importance in this connection. Did the earth receive a considerably larger supply of heat, Greenland, Spitzbergen, the vast Antarctic continent, and many other portions of the frigid zones now waste, might be covered with luxuriant crops. Hence it is not so much the *persistence*, as the present *quantity* of light and heat, which gives the physical limit of population.

We may go further: the invariability of the total amount of energy in the universe is not to be called in question. But that our earth will continue for ever to receive the same share of light and heat as she now does is, in the present state of knowledge, not to be supposed. The sun, which took its origin in time, must in time cool down, and cease to irradiate the planets. The planets themselves will have long ago dissipated their stock of internal heat, and will therefore either continue to roll round the extinct sun as dark, dead bodies,—the corpses of worlds,—or will, one by one, have fallen into the decaying luminary, and for a time have revived his power.

The latter case is, of course, instant destruction. The former must mean a gradual decrease of the light and heat, which even now is insufficient to maintain the whole globe in a condition fit for the maintenance of higher plant and animal life. Consequently the time must come—though it may be yet far remote, and may approach very slowly—when the lifeless and useless portions of the globe will broaden, and when death and sterility will creep from the Poles into what are now temperate regions. Surely the persistence of energy affords a shadowy basis for a faith in the possibility of a population of a thousand billions!

We come now to the second truth upon which Mr. George builds his extravagant estimate. Matter is, as far as we can perceive, indestructible. Be it so. But matter, as every school-boy is in these days supposed to know, consists of some seventy distinct kinds, not by any human agency convertible one into another. Of some of these kinds the supply is practically indefinite, whilst that of others is very limited. Now it happens that some of the elements which are employed in building up the bodies of plants and animals, and without which they cannot exist, are comparatively scarce.

One of these elements is phosphorus. Without it plants cannot grow. Without it the nervous system and the bones of animals cannot be formed. Now—borrowing an illustration from a critique in the "Chemical News"—we will suppose a planet which contains in its rocks, its soils, and its waters, a million ounces of phosphorus in different states. Suppose such planet inhabited by a race of beings, each of which, on an average, contains an ounce of phosphorus in its body. The eternity of phosphorus, and of every other form of matter notwithstanding, it is plain that a thousand millions of such beings could not co-exist upon the face of the planet in question.

It is surely, then, evident that the limit to population is given by the *quantity of certain kinds* of matter, their indestructibility being utterly unable to make one ounce play the part of two, or of a hundred or of a thousand ounces.

But we may go very much farther. We cannot live on—or, in more technical language, we cannot assimilate—the elements such as they exist in the free state, or in inorganic combinations in the air, the water, and the rocks. Our need for phosphorus has been already referred to. But if we take into our stomachs free, pure phosphorus, in its uncombined condition, the result is not nutrition, but death. Or suppose we take one of its mineral compounds, such as apatite, a phosphate of lime, or vivianite, a phosphate of iron, grind it into the finest powder, and swallow it. Will it in any way nourish us? Will it supply our bodies with the phosphorus which they need? Not in the least. It will be excreted just as it was eaten, unchanged and undigested.

Another essential component of our bodies is nitrogen. The atmosphere, we know, contains a relatively infinite supply of nitrogen in the free or elementary state. We take this nitrogen into our bodies at every breath we draw; but it is not retained and assimilated: we exhale it again unchanged precisely as we drew it in.

Just the same is the case with carbon, one of the most abundant components of our bodies. It exists in the diamond, in graphite, in anthracite in a nearly pure condition. It is found in the air, in the form of carbonic acid. But we cannot obtain the carbon we want by eating graphite or inhaling carbonic acid.

In like manner we might pass through the whole list of substances which go to build up our bodies, and show that we cannot obtain them from mineral sources. Our supply of all these substances is drawn from the consumption of vegetable and animal matters containing them in *organic*

combination. And these compounds which nourish us are not eternal or indestructible; they are very easily destroyed, and their elaboration is tedious. So far we cannot make even the simplest of them artificially. We cannot, so far, take the oxygen and hydrogen of water and the carbon of coal or chalk, or of the atmosphere, and combine them together so as to form starch, or sugar, or oil. We have to depend on the agency of plants, and to wait while they effect the task, which, in regions outside the tropics, they only carry on for about half the year. Plants, then, can extract phosphorus, and lime and sulphur, &c., from the soils; carbon, oxygen, hydrogen, and nitrogen from the air, the water, and from the remains of plants and animals which have ceased to live, and can elaborate the whole into compounds which we in turn can digest and assimilate, or, in other words, make part of ourselves. One task, however, the plant is unable to do: it cannot, as the most careful experiments show, take the free nitrogen of the air and assimilate it. It has to depend upon certain compounds of nitrogen, such as ammonia and nitric acid, which exist in the air, the water, and the soil, but to *a very limited extent.* Now these compounds of nitrogen are being formed but slowly, and they are very liable to destruction, *i.e.*, to a decomposition into free nitrogen. Whether the entire stock of combined nitrogen in the world is maintained at a constant level, or is decreasing, is a very doubtful question. It is certain that if we allow animal matter, blood, flesh, urine, &c., to putrefy, a certain proportion of the nitrogen present escapes as free nitrogen.

Whether man will ever succeed in making the nitrogen of the atmosphere available as plant-food,—and hence ultimately as human food,—by converting it into ammonia or nitric acid, time only can show. Many experimentalists have grappled with this grand problem, and ammonia, &c., have been actually produced, but so far the cost of the article obtained has exceeded its value. Hence it is, for the present, premature to take the free nitrogen of the atmosphere into account as a possible source of food.

Now why do we mention the above facts, which, to many of our readers at least, must be a thrice-told tale? Simply to remind them how very much more of the elements of food are required than what is, at any given moment, locked up in human bodies. To take a very simple illustration: a trader needs not merely capital sufficient to stock his shop; he requires funds sufficient to maintain himself, to meet all current expenses, and to buy in fresh goods until the pay-

ments for his first sales have come in. Just so here. Let us take the single case of phosphorus. Besides the quantity contained in the bodies of man and other animals, there is a reserve-capital in the soil; there is a further stock of phosphorus in the bodies of the dead and the excreta of the living which is being gradually converted into plant-food, and there is a further quantity accumulating in the tissues of plants, but not available until the crops have reached maturity. All these items form, so to speak, the world's working capital of phosphorus. Is there the remotest possibility that this capital is large enough to enable her to conduct operations a *million times* larger than those which even now appear at times to cripple her resources?

As with phosphorus so with combined nitrogen, and more or less with all the rarer constituent elements of our bodies.

We have still, however, one important consideration, *viz.*, the fact that a very large proportion both of the excreta and of the dead bodies of mankind are, so to speak, *withdrawn from circulation.* The liquid and solid excrements of the four million inhabitants of London, together with their household refuse of various kinds, are let flow into the sea. How long it may be before they can reappear in the form of plant-food—much more of human food—it is impossible to calculate.

We have thus shown that the chemical limit of possible population depends not on the "eternity" of matter, but on the supply of certain kinds of matter as existing in certain conditions, which are anything but eternal.

There is another limit easily overlooked by orators and enthusiasts. Every sanitarian knows the difficulty of obtaining, for domestic purposes, a sufficiency of pure water untainted by putrescent or putrescible animal matter. Let us imagine the population, and consequently the quantity of pollution increased *a millionfold.* How is pure water to be procured? In like manner, how are the excreta of such a fearful multitude to be disposed of? Where will be the gathering-grounds for water, the irrigation-farms, or even the precipitation-tanks, when an uninhabited acre will be a rarity?

There is a further limit to population, having its seat in the organic world. So far we have found that as man increases, and as the plants and animals which he cultivates and protects multiply, there increase also other species of plants and animals which are man's enemies, or, in more modern phraseology, his competitors. These enemies either

insist upon sharing man's food, and from their numbers and their minuteness contrive to get the first share, leaving him the residue; or they attack our food-plants in an immature state, and to a great extent prevent them from growing. These beings—from rats, mice, and sparrows, down to the *Phylloxera*, and even to the Fungi which occasion the potato-disease, the coffee-disease, the rust and smut in wheat, and to the microbia of splenic fever in cattle and sheep—are so numerous and varied that a mere catalogue would exceed the space at our disposal. Fortunately nothing of the kind is needed. Man hitherto has been very unsuccessful in waging war with these enemies. In how few countries have even the larger beasts of prey been completely stamped out! As for the smaller pests, they—as we have already hinted—"grow with man's growth and strengthen with his strength." We have—or rather had, for they have been stolen by some visitor—a couple of specimens of the Colorado beetle, captured in New Mexico some thirty years ago. In those days it was a not very-common species, one, amongst other Chrysomelidæ, living on wild Solanaceæ, and not interfering with man's well-being. But as cultivation was extended, and as potato-fields came into existence near the haunts of this harmless beetle, it suddenly multiplied to an extent heretofore unknown, selected the potato as its food-plant, swept the country to the Atlantic, and destroyed untold thousands of tons of what would otherwise have been human nutriment. Such has been the career of other vermin, pests, and parasites, and such it will continue, to an increasing extent, unless man finds out new and improved means for their destruction. Here, then, we have what may be called the biological limit to population.

The war against poverty must be waged by means of invention and discovery. He who can increase the supply of plant-food, or who can form human food synthetically from its elements, does far more for the well-being of his fellows than all the orators and agitators of the day. But scientific research is less exciting to the multitude than mass-meetings, processions, and inflammatory harangues.

As for the "deductions" of Mr. Henry George, we hope that the passage which we have quoted from his work is not a fair average specimen; otherwise there is woe in store for his followers, and for the world at large in proportion as his teachings meet with acceptance.

II. VACCINATION.

By G. S. Gilebs.

IS Vaccination scientific? The late President of the Royal Society thought it involved "a scientific principle"; but if it be true, as it certainly largely is, that "Science is measurement," then our object of research should be capable of definition. The importance of clear definition is that it relieves the mind from idle speculation. But here is our initial difficulty; for the word Vaccination has become a sort of conventional term, and is applied to many things which could not have been in the mind of Jenner.

Dr. Ballard, in his Prize Essay "On Vaccination," says, in reference to infant vaccination, that "medical man and parent alike," and again, in reference to adult vaccination, "the patient and surgeon alike, should not suppose that in the act of vaccination they were engaged in the peformance of a rite, but remember seriously that the object is *the infliction of a disease.*" It might be supposed that the business of a physician, consulted by a parent as to the health of a child, would be to cure, not to inflict, disease; and equally, that the last thing a surgeon would do would be to operate in any way upon a perfectly healthy body. It is interesting to notice that, as vaccination is no part of either medicine or surgery, the author divides the objects of solicitude between the physicians and surgeons, lest he should create jealousy, and hands over the infants to the former, while the adults have to face the latter. But whatever hesitancy there may have been on this point, there is none as to the "infliction of disease." And, extraordinary as this may appear, he is supported in it by no less eminent an authority than the late Dr. Farr, who, in one of his many excellent letters to the Registrar-General, lays down some sanitary rules, and among them this:—"*Fortify the body by a mild disease,* if such is known, against a severe disease. Vaccination, or even Inoculation, if Vaccination had not been discovered, is properly practised under this rule." It may be allowed to conjecture that such a rule would never have issued from the clear intellect of Dr. Farr if the practice had not preceded it.

In our scientific research we have now advanced one step. Vaccination is the infliction of disease. We proceed to enquire what disease? There are three kinds connected

with the practice which may be distinguished, though not scientifically definable,—the disease *à la* Jenner, *à la* Ceely, and *à la* Cameron, all supposed to be prophylactic of smallpox. According to Jenner it was the disease of cowpox, and that not the eruption arising as an outward manifestation of bad health in the cow, but the effect of transmission from the diseased horse, by the accident of dirty grooms acting as milkmaids. He describes the effect of inoculating this disease upon the healthy human frame:—"Absorption takes place, and tumours appear in each axilla. The system becomes affected, the pulse is quickened; shiverings succeeded by heat, general lassitude, and pains about the loins and limbs, with vomiting, come on. The head is painful, and the patient is now and then even affected with delirium. These symptoms, varying in their degree of violence, generally continue from one day to three or four, leaving ulcerated sores about the hands, which, from the sensibility of the parts, are very troublesome, and commonly heal slowly, frequently becoming phagedenic, like those from which they sprang." A little further on in the same treatise he remarks:—"But what renders the cowpox virus so extremely singular is, that the person who has been thus affected is for ever after perfectly secure from the infection of smallpox." Vaccination of this kind is now seldom met with; but a case, a few years ago, fell under our observation in which the prediction was certainly fulfilled, for the infant succumbed in a few days, and the rarity of the occurrence was attested by the medical attendant certifying the death as from *measles*. When the gentle and reverend father meekly suggested that the measles were of an unusual kind, the reply was "Yes, they were suppressed, you see." And so was the truth at the same time, by honest ignorance.

The disease *à la* Ceely originated about fifty years after the disease *à la* Jenner. The more frequent occurrence of smallpox after operations for cowpox gave rise to the idea that the virus was enfeebled, attenuated, or diluted beyond the point of usefulness, and that it required to be renewed or somehow strengthened. This led to the development by Mr. Ceely, of Aylesbury, of the notion that the cowpox and smallpox were essentially identical, by inoculating matter taken from smallpox patients on cows, and subsequently inoculating the human frame with the product. The result was the appearance of normal vaccine vesicles. This performance was lauded in the House of Commons, by Mr. Lowe, as the most wonderful improvement in the practice of vaccination, and was by some supposed to supply a more

reasonable basis for it than it had yet had. This disease *à la* Ceely is more frequently observable than the disease *à la* Jenner, especially in those times when the atmospheric conditions are such as to favour the spread of smallpox. So frequently does smallpox make its appearance very soon after vaccination, and so frequently does this smallpox concurrent with cowpox (so called) prove fatal, that the Registrar-General was prevailed upon to lay down a rule that such deaths by smallpox as occurred within three weeks of the operation should be recorded as *unvaccinated* smallpox, while they were really the natural and scientific result of Ceelyism.

Of the precise effects of the disease *à la* Cameron it is not possible to say very much, because it is not yet sufficiently patronised; but it may be interesting to note the cause of its invention. The more or less constant recurrence of unforeseen results in the course of operations, presumably consequent upon the accession from the numerous bodies operated on of various poison germs to unite with and accompany the virus inserted, led to extended controversies, to which lack of space forbids further allusion, and eventually to the official recognition as vaccination of the practice of taking some virus from an animal which had developed sores, as a consequence of bad health and keeping this morbid virus in motion by constantly transferring it from calf to calf. This virus is said to be innocuous. But innocuous virus is a thing scarcely known to Science, and already complaints are being heard of unexpected results.

A consideration of these circumstances will lead us readily to see that definition is not very easy. When we face the small sack of poisonous matter delicately named a vaccine vesicle, which is to provide us with the means of inflicting disease, what knowledge can we have of its contents? How can we know what disease we are about to inflict by its aid? Does it contain a germ of the horse poison accidentally communicated to the cow nearly a century ago? Does it contain a germ of the smallpox virus inflicted on the cow thirty years ago? Does it contain a germ, the outcome of the cow's own internal disorder, said to be innocuous? Further, does it contain a germ the outcome of some internal disorder of the person on whom it is, or of the person or persons from whom the matter has been transmitted? Do medical art and surgical science, either or both, supply us with any answers to these questions? Whether they do or can is, however, of small importance as compared with the answer to the practical question, whether the multiplied

and renewed infliction, haphazard, of diseases, results in the reduction of smallpox? It is often asserted that no one ever pretended that vaccination would abolish smallpox. But Jenner told the House of Commons, in 1802, that he confidently expected the extension of the inoculation of the cowpox to do so, and in 1852 the Epidemiological Society, or rather the late Dr. Seaton, assured the House of Lords that "everybody was liable to smallpox unless vaccinated"—a dictum untrue both in what it asserts and what it implies. We have the means of testing the value of these predictions in our own country by the Death Register, which is sufficiently accurate for our purpose, since the year 1838. We find, then, from the Death Register for England and Wales, that between the years 1838 and 1853, while vaccination was voluntary, the annual smallpox mortality varied from 2715 to 16,268; and between the years 1854 and 1872, with vaccination largely increased under compulsion, from 1320 to 22,907. The variations in London for the same periods, respectively, were from 211 to 3817, and from 156 to 7876. We have at hand the record, for the years 1855 to 1873) of smallpox mortality in Scotland, which in point of population is something like London turned out into the country. Here we find that for the years 1855 to 1864, under voluntary vaccination, the variation was from 426 to 1741; and for the years 1865 to 1873, under compulsion, from 15 to 2448.

It seems difficult, in the face of these figures, to see value in vaccination as a prophylactic.

But we have another witness to call in the Reports of the French Academy of Medicine, which collect from the several Departments of France an account not only of the deaths by smallpox, but also of the cases occurring year by year. These Reports have been carefully examined and collated for the years 1865, 1866, and 1867, and each tells the same tale. There is no direct compulsion on this subject in France, and the greatest diversity of practice exists in the several Departments. Thus, the whole country being divided into two groups of Departments, *viz.*, those in which the proportions of vaccinations to births reach 50 per cent (averaging 77 per cent) and those in which the proportion is less (averaging 35 per cent), we find that for the former group the cases were (in proportion to 10,000 births), in 1865, 569 as compared with 222 for the latter, less vaccinated group. In 1866 the corresponding record is 400 to 130; and in 1867, 254 to 83. Here we have surely a clear evidence that the extension of vaccination does not necessitate a diminution of smallpox.

But if the vaccinated are in no better position than the unvaccinated with regard to attack, are they not better situated with regard to recovery? The answer of the French record is clear to the contrary. Taking the years and groups of Departments as above, the figures in regard of smallpox deaths to births are 52 to 17, 52 to 11, and 28 to 8. The less vaccination, the less smallpox mortality.

Yet further, the proportions of smallpox deaths to smallpox cases for the same groups and years are, in percentages, 9·1 to 7·7, 12·9 to 8·5, and 10·6 to 9·2; or for the three years taken together, 10·86 in the Departments most vaccinated to 8·46 in the Departments least vaccinated. These facts are so much opposed to the constant assertions made respecting the greater fatality of smallpox among the unvaccinated, on the authority of Hospital reports, that we must now endeavour to bring a little scientific measurement to bear on these.

To obtain our standard rule we must revert to the condition of things in the last century, in this country, when and where the smallpox was a more or less constant subject of controversy. The controversy arose in this manner:—Lady Mary Wortley Montague returned from Turkey imbued with the desire to introduce the Turkish method of inoculation of the smallpox as a means of averting an attack of the disorder when epidemically prevalent. All English physicians did not take kindly to the notion; and when her ladyship's influence at Court procured the release of six prisoners from Newgate, conditional on their submitting to the operations of Mr. Maitland, there were pretty lively passages of literary arms among the medical men who took an interest in the subject, the operator and his friends reporting a complete success, and others denying that the disease inflicted had any of the proper characteristics of smallpox. None of the six died, however, from the effects of the operation, and fashion and fashionable physicians speedily arranged themselves by the side of her ladyship. Among these was Dr. Jurin, some time Secretary of the Royal Society, who took the very obvious method of recommending the new practice by contrasting the small fatality resulting from it with the general fatality of smallpox occurring in the usual way. He was an industrious, clever, and honest partizan, and, by no small efforts, he collected from different parts of this country records of various epidemic attacks amounting altogether to 18,066 cases with 2986 deaths, being a fatality of 16·53 per cent. The conclusion that this should be accepted as the normal fatality of

natural smallpox was hotly contested by Dr. Wagstaffe, a well-known contemporary of Jurin, who declared that when he wrote the fatality of smallpox did "not exceed one in a hundred." And Isaac Massey, at the same period, Apothecary to Christ's Hospital, stated that in several years only one child ("and he a surgeon's patient before") had died of the disorder, although "hundreds had been down of it." Time operates with cooling wings; and we may fairly suppose all partizan heat dissipated when the writer of the article on Smallpox Inoculation for "Rees's Cyclopædia," published in 1779, stated that "From a general calculation it appears that, *in the hospitals* for smallpox and inoculation, 72 die out of 400 having the distemper in the natural way, and only one out of this number when inoculated." That is, in the smallpox hospitals in this country in the last century, all the patients being necessarily unvaccinated, the fatality was 18 per cent. We take this as our standard rule. Now the disorder of smallpox being always of the same general character, "changed in nothing," and hospital accommodation at present not being inferior to that of the last century, we might fairly expect the hospital fatality now to be about 18 per cent for the unvaccinated, and proportionately less in the total as the proportion of vaccinated patients increased, *if it were true* that these died at a lower rate than the others. On the basis of a death-rate for the vaccinated of (say) one-fourth of that of the unvaccinated, what would be the total fatality in a hospital where one-half of the patients were vaccinated? Answer, $11\frac{1}{4}$ per cent. On the same basis, what would be the total fatality in hospitals where three-fourths of the patients were vaccinated? Answer, $7\frac{7}{8}$ per cent. But in the Highgate Smallpox Hospital, during the sixteen years 1836 to 1851, there were 5652 patients, of whom 3094 (more than half) were classed as vaccinated, yet the fatality in the total was 19·97 per cent; and in the hospitals under the care of the Metropolitan Asylums Board, during 1870, '71, and '72, there were 14,808 patients, of whom no less than 11,174 (just over three-fourths) were classed as vaccinated, yet the fatality in the total was 18·66 per cent. That is to say, that what is proved true of the populations at large of England, Scotland, and France, is proved true also of the patients in smallpox hospitals, that the extension of vaccination has no diminishing effect upon the smallpox death-rate.

Although these hospital reports, which may be taken as typical, for almost all those published are drawn up on the same lines, reveal in this striking manner the failure of

vaccination to mitigate any more than to protect, they are constantly appealed to for proof of the value of vaccination as a life-saver from smallpox after attack, because a differential fatality is stated for the unvaccinated and the vaccinated. Thus Mr. Marson states that the unvaccinated died at the rate of 35·55 per cent, and the vaccinated at the rate of 6·76 per cent; and the Metropolitan Board state that their unvaccinated patients died at the rate of 44·80 per cent, and the vaccinated at the rate of 10·15 per cent. These figures are simply incredible for those who are acquainted with the nature and history of the disorder; for not only is there no reason—physiological, pathological, or other—for supposing that the vaccination of the vaccinated diminishes their own risk when attacked, but, *à fortiori*, no reason for supposing that the operations performed on their bodies could anyhow increase the risk of death for those who had not had any disease inflicted upon them.

It has been said that to question their accuracy implies a charge of conspiracy to deceive on the part of Smallpox Hospital doctors the world over; but a little consideration will show that they are the outcome of a somewhat indolent want of thought.

The disorder of smallpox is one of very various degrees of danger, according to the sparseness or abundance of the eruption, and the severest and most probably fatal cases are those of the kind called confluent, in which the pustules run together, and completely cover large portions, or the whole, of the body. Yet the classification is made according to the rule that evidence of vaccination consists in the visibility of marks,—a rule certainly misleading in the case of such a disorder, as is clearly pointed out by Dr. Russell, of Glasgow, who, in giving some information about Hospital Smallpox in that city, states that some (he does not say how many) patients who had been recorded on admission as unvaccinated, because of the absence or invisibility of marks, when they became convalescent showed marks of vaccination, "some of them very good." He amended his record in consequence, but yet left it erroneous,—a double-thonged whip for the Anti-Vaccinists; for the patients who died, died "unvaccinated," while those who recovered went to swell the list of "vaccinated" recoveries. An additional proof of the accuracy of this explanation is afforded by the introduction into more recent hospital reports of a column of "doubtful," or "said to be vaccinated, but having no marks"; and these classes show, as would be reasonably expected, a very high rate of fatality.

We conclude, then, that Vaccination is not scientific; that it cannot be accurately defined; that it is completely useless for its assumed purpose; that fortification of the body by disease is a mischievous myth, and that the sooner the practice is discontinued the better it will be for the health of the community.

III. THE UPRIGHT ATTITUDE OF MANKIND.

EVERYONE must have heard or have read of the supposed perfect adaptation of the human frame to bipedal locomotion and to an upright attitude, as well as of the advantages which we gain by this erect position. We are told, and with perfect truth, that in man the occipital foramen—the aperture through which the brain is connected with the spinal cord—is so placed that the head is nearly in equilibrium when he stands upright. In other Mammalia this aperture lies further back, and takes a more oblique direction, so that the head is thrown forwards, and requires to be upheld partly by muscular effort and partly by the ligamentum nuchæ, popularly known in cattle as the "pax-wax."

Again, the relative lengths of the bones of the hinder extremities in man form an obstacle to his walking on all-fours. If we keep the legs straight we may touch the ground in front of our feet with the tips of the fingers, but we cannot place the palms of the hands upon the ground and use them to support any part of our weight in walking. Not a few other points of a similar tendency have been so often enlarged upon, in works of a teleological character, that there can be no need even to specify them at present.

But till lately it has never been asked "Is man's adaptation to an upright posture perfect?" and "Is this posture attended with no drawbacks?" These questions have been raised by Dr. S. V. Clevenger in a Lecture delivered before the Chicago University Club, on April 18th, 1882, and recently published in the "American Naturalist." This Lecture, we may add, cost the speaker the chair of Comparative Anatomy and Physiology at the Chicago University!

Dr. Clevenger first discusses the position of the valves in the veins. The teleologists have long told us that the valves in the veins of the arms and legs assist in the return of blood to the heart against gravitation. But what earthly use has a man for valves in the intercostal veins which carry blood almost horizontally backwards to the azygos veins? When recumbent these valves are an actual obstacle to the free flow of the blood. The inferior thyroid veins which drop their blood into the innominate are obstructed by valves at their junction. Two pairs of valves are situate in the external jugular, and another pair in the internal jugular, but they do not prevent regurgitation of blood upwards.

An anomaly exists in the absence of valves from parts where they are most needed, such as the venæ cavæ, the spinal, iliac, hæmorrhoidal, and portal veins.

But if we place man upon all-fours these anomalies disappear, and a law is found regulating the presence or absence of valves, and, according to Dr. Clevenger, it is applicable to all quadrupeds and to the so-called Quadrumana. Veins flowing towards the back—*i.e.*, against gravitation in the all-fours posture—are fitted with valves; those flowing in other directions are without. For the few exceptions a very feasible explanation is given.

Valves in the hæmorrhoidal veins would be useless to quadrupeds; but to man, in his upright position, they would be very valuable. "To their absence in man many a life has been and will be sacrificed, to say nothing of the discomfort and distress occasioned by the engorgement known as piles, which the presence of valves in their veins would obviate."

A noticeable departure from the rule obtaining in the vascular system of Mammalia also occurs to the exposed situation of the femoral artery in man. The arteries lie deeper than the veins, or are otherwise protected, for the purpose—as a teleologist would say—of preventing serious loss of blood from superficial cuts. Translating this view into evolutionary language, it appears that only animals with deeply-placed arteries can survive and transmit their structural peculiarities to their offspring. The ordinary abrasions to which all animals are exposed, not to mention their onslaughts upon each other, would quickly kill off species with superficially-placed arteries. But when man assumed the upright posture the femoral artery, which in the quadrupedal position is placed out of reach on the inner part of the thigh, became exposed. Were not this defect greatly compensated by man's ability to protect this part in

ways not open to brutes, he, too, might have become extinct. As it is, this exposure of so large an artery is a fruitful cause of trouble and death.

We may here mention some other disadvantages of the upright position which Dr. Clevenger has omitted. Foremost comes the liability to fall due to an erect posture supported upon two feet only. Four-footed animals in their natural haunts are little liable to fall; if one foot slips, or fails to find hold, the other three are available. If a fall does occur on level ground there is very little danger to any mammal nearly approaching man in bulk and weight. Their vital parts, especially the heart and the head, are ordinarily so near the ground that to them the shock is comparatively slight. To human beings the effects of a fall on smooth, level, ground are often serious, or even deadly. We need merely call to mind the case of the illustrious physicist whom we have so recently and suddenly lost.

The upright attitude involves a further source of danger. In few parts (if any) of the body is a blow more fatal than over what is popularly called the "pit of the stomach." In the quadruped this part is little exposed either to accidental or intentional injuries. In man it is quite open to both. A blow, a kick, a fall among stones, &c., may thus easily prove fatal.

Another point is the exposure and prominence of the generative organs, which in most other animals are well protected. Leaving danger out of the question, it may be asked whether we have not here the origin of clothing? The assumption of the upright posture may have made primitive man aware of his nakedness.

Returning to the illustrations furnished by Dr. Clevenger we are reminded that another disadvantage which occurs from the upright position of man is his greater liability to inguinal hernia. In quadrupeds the main weight of the abdominal viscera is supported by the ribs, and by strong pectoral and abdominal muscles. The weakest part of the latter group of muscles is in the region of Poupart's ligament, above the groin. Inguinal hernia is rare in other Vertebrates because this weak part is relieved by the pressure of the viscera. In man the pelvis receives almost the entire load of the intestines, and hence Art is called in to compensate the deficiencies of Nature, and an immense number of trusses have to be manufactured and used. It is calculated that 20 per cent of the human family suffer in this way. Strangulated hernia frequently causes death. The liability to femoral hernia is in like manner increased by the upright position.

Now if man has always been erect from his creation,—or, if that term be disliked, from his origin,—we have evidently nothing to hope from the future in the way of an amendment of this and other defects. But if we have sprung from a quadrupedal animal, and have by degrees adopted an upright position, to which we are as yet imperfectly adapted, the muscular tissues of the abdomen will doubtless in the lapse of ages become strengthened to meet the demand made upon them, so that the liability to rupture will decrease. In like manner the other defects above enumerated may gradually be rendered less serious.

A most important point remains: the peritoneal ligaments of the uterus fully subserve suspensory functions. The anterior, posterior, and lateral ligaments are mainly concerned in preventing the gravid uterus, in quadrupeds, from pitching too far forward towards the diaphragm. The round ligaments are utterly unmeaning in the human female, but in the lower animals they serve the same purpose as the other ligaments. Prolapsus uteri, from the erect position and the absence of supports adapted to that position, is thus rendered common, destroying the health and happiness of multitudes.

As a simple deduction from mechanical laws it would readily follow that any animal or race of men which had for the longest time maintained an erect position would have straighter abdomens, wider pelvic brims with contracted pelvic outlets, and that the weight of the spinal column would force the sacrum lower down. This, generally speaking, we find to be the case. In quadrupeds the box-shaped pelvis, which admits of easy parturition, is prevalent, Where the position of the animal is such as to throw the weight of the viscera into the pelvis, the brim necessarily widens, these weighty organs sink lower, and the heads of the thigh-bones acting as fulcra permit the crest of the ilium to be carried outwards, whilst the lower part of the pelvis is at the same time contracted.

In the innominate bones of a young child the box-shape exists, whilst its prominent abdomen resembles that of the gorilla. The gibbon exhibits this iliac expansion through the sitting posture which developed his ischial callosities. Similarly iliac expansion occurs in the chimpanzee. The megatherium had wide iliacal expansions due to its semi-erect habits; but as its weight was in great part supported by the huge tail, and as the femora rested in acetabula placed far forwards, the leverage necessary to contract the lower portion of the pelvis was absent.

Prof. Weber, of Bonn, quoted in Karl Vogt's "Vorlesungen über den Menschen," distinguishes four chief forms of the pelvis in mankind,—the oval in Aryans, the round among the Red Indians, the square in the Mongols, and the wedge-shaped in the Negro. Examining this question mechanically it would seem that the longer a race had remained in an upright position the lower is the sacrum, and the greater is the tendency to approximate to the larger lateral diameter of the European female. The front to back diameter of the ape's pelvis is usually greater than the measurement from side to side. A similar condition affords the cuneiform, from which it may be inferred that the erect position in the Negro has not been maintained so long as in the Mongol, whose pelvis has assumed the quadrilateral shape owing to persistence of spinal axis weight for a greater time. This pressure has finally culminated in forcing the sacrum of the European nearer the pubes, with consequent lateral expansion and contraction of the diameter from front to back. From the marsupials to the lemurs the box-shaped pelvis remains. With the wedge-shape occasioned in the lowest human types there occurs a further remarkable phenomenon in the increased size of the fœtal head accompanying the contraction of the pelvic outlet. While the marsupial head is about one-sixth the size of the narrowest part of the bony parturient canal, the moment we pass to erect animals the greater relative increase is there seen in cranial size, with a coexisting decrease in the area of the outlet. This altered condition of things has caused the death of millions of otherwise perfectly healthy and well-formed human mothers and children. The palæontologist might tell us if some such case of ischial approximation by natural mechanical causes has not caused the probable extinction of whole genera of Vertebrates. "If we are to believe that for our original sin the pangs and labour of childbirth were increased, and if we also believe in the disproportionate contraction of the pelvic space being an efficient cause of the same difficulties of parturition, the logical inference is that man's original sin consisted in his getting upon his hind legs."

This subject is not without direct applications. Accoucheurs cause their patients to assume what is called the knee-chest position, a prone one, for the purpose of restoring the uterus to something near a natural position. Brown-Sequard recommends, in myelitis, or spinal congestion, drawing away the blood from the spine by placing the patient on his abdomen or side, with hands and feet somewhat hanging down. The liability to *spina bifida* is greatest

in the human infant, through the stress thrown on the spine. The easy parturition in the lower human races is due to the discrepancy between cranial and pelvic sizes not having been as yet reached by those races. The Sandwich Island mother has a difficult delivery only when her child is half white, and has consequently a longer head than the unmixed native strain.

At present the world goes on in its blindness, apparently satisfied that everything is all right because it exists, ignorant of the evil consequences of apparently beneficial peculiarities, vaunting man's erectness and its advantages, whilst ignoring the disadvantages.

The observation that the lower the animal the more prolific (not universally true!) would warrant the belief that the higher the animal the more difficulties encompass its propagation and development. The cranio-pelvic difficulty may perhaps settle the Malthusian question as far as the higher races of men are concerned by their extinction.

[If the facts brought forward by Dr. Clevenger cannot be controverted, they seem to prove that man must have originated by gradual development from a four-footed being. Had he been created an erect, bipedal animal, as we find him, his structure would have been not in partial, but in perfect, adaptation to the conditions of that attitude. That some of the peculiarities of his structure are better in harmony with a horizontal than a vertical position of the spinal column, is perhaps the strongest argument against the theory of direct creation and the radical *toto cœlo* distinction between man and beast that has yet been advanced. We cannot at the moment lay our hands upon any thorough and trustworthy account of the valves in the veins of the sloth: as that animal spends its life hanging, back downwards, the structure of the veins would be interesting in this connection.—Ed. J. S.]

IV. IF TRUE?

"We may depend upon it that when Science and Theology are both sufficiently awake to see a common enemy in Spiritualism, there will be lively times."—*Light.*

WHEN a new power makes its appearance in our midst all men naturally raise the question of its probable bearings upon the existing order of things. Such an inquiry is no less pertinent in the case of a new and strange philosophy than of a newly founded empire. What will it support and befriend? What will it seek to controvert and overthrow? Is it compatible or incompatible with what we know, or think we know, already? Until these questions are satisfactorily answered the world of thought feels a curiosity largely blended with unrest.

Such is the attitude of a large proportion—may we not say of the majority?—of educated persons concerning Spiritualism. This new body of beliefs is no longer ignored. It has evidently tinctured current literature. It would be a heavy task to count up the books, or the articles in magazines and newspapers, which would never have been written but for "table-turnings" and rappings which originated some thirty years ago. Such being the case we may legitimately ask, What if these things are so? Supposing—as we neither affirm nor deny—that the claims of Spiritualism are in the main well-founded, what must follow? Will it come as an addition to our present knowledge, involving, perhaps, more or less of the rectifications which every new discovery of moment brings about? or will it run counter to our fundamental principles and to our very methods of inquiry?

A difficult question may be raised at the outset: what are the claims and the tenets of Spiritualism, and who are its authorised interpreters? It has no teachers either ordained by an infallible Church or examined and "passed" by a still more infallible "Department." But we may fairly accept, as parts of its belief, assertions which we find made in its organs and not subsequently retracted or disavowed.

Its first point, the existence of "spirit" as a substantive essence distinct from matter, and not a modification of energy, need not engage our attention. This doctrine, though of course at issue with the monistic interpretation of the universe, is accepted by the majority of civilised mankind

at the present day, including, probably, the greater portion of men of Science.

But Spiritualism, further, would have us believe that when a man is dead his spirit not merely continues to exist, but remains locally among us, and is able to interfere both with living beings and with lifeless matter. Certain phenomena are said to have been produced not referrible to any known agency, nor, so far as could be detected, due to jugglery, fraud, or collusion. It is further contended that these phenomena are produced not by any agency, as yet unknown, of the same order as light, heat, electricity, or the like, but by agents, intelligent, personal, and possessing will. It is said, moreover, that "the intelligence is not that of (living) persons present, but is different from and frequently surpasses it."

Very brief reflection will suffice to convince us of the grave importance of this claim. We men of Science have hitherto recognised will and intelligence only of two kinds. Those of us who accept the theistic interpretation of the universe admit in consequence a Divine will, infinite and unchanging, and consider that the earth and the fulness thereof have been called into being and are still upheld by the action of this Will. Hence we regard it as a "constant" not merely compatible with but underlying the invariability of Nature, or the sequence of cause and effect. We may add that the Agnostic does not deny the possible existence of such a Will, though he finds no positive evidence in its favour.

Besides this Infinite Will we have been accustomed to recognise will and intelligence in animals, and especially in man. We know that such will and intelligence often, or rather constantly, interfere with the "order of Nature," and we cannot regard them, like the Divine will and intelligence, as "constants."

But we know when and where the will of man, or of other animals, is being exerted, and where it is not. We know, approximately at least, the limits of their power and the conditions under which it can be exerted. Hence neither the Divine nor the human will can interfere with our results and our theories. We have no evidence that God will alter the atomic weight or the specific gravity of any element. We know that man cannot. We have no reason to suspect that God ever caused, or is likely to cause, light issuing from a given point to decrease in any other ratio than inversely as the square of the distance. We know that man cannot. We do not find God sometimes cancelling the

force of gravitation by causing a table to rise, say, up to the ceiling of a room where it stood. We know that man can do this only by means of certain appliances, natural or artificial. Thus he must either lift the table up from below, or raise it by ropes from above, or buoy it up by attaching to it some substance lighter than common air, such, *e.g.*, as a balloon filled with hydrogen gas. It is upon this knowledge of the constancy of the Divine will, and of the limits and mode of action of human power, that our conception of an established order in the universe, of so-called laws of Nature, is founded. It is thus that we are able, in the simpler and better-known classes of phenomena at least, to predict the future,—to know what will happen under given conditions. If, still employing the theistic hypothesis, God were, from time to time and at irregular intervals, to modify the properties of matter and the action of energy, we should be intellectually confounded and put to shame. Science—and we mean here not Science as at present constituted, but any co-ordinated body of knowledge—would be simply impossible: not merely so, but the practical business of common life would be paralysed. The belief in the uniformity of Nature extends even below the human species. According to some experiments performed by Mr. Romanes a dog has exhibited something very like superstitious fear when a bone, with which he was playing, was suddenly jerked by means of a slender silk cord.

Or suppose even that a man, sitting in his chair, could by a mere effort of will move objects at the other side of the room without touching them directly or indirectly; even then we should be in a state of the utmost perplexity until we knew the precise limits of this power and the conditions under which it is exerted.

It seems now to us that if the contentions of Spiritualism are true, we are placed, for the present at least, in a position not unlike what we should occupy if the Deity were capricious, or if man could exert his activity without the ordinary appliances. We are told that there exist around us beings, ordinarily invisible, capable of interfering in the order of things, and possessing greater power than man. We neither know the limits of this power, the conditions of time, place, and circumstance under which it is exerted, nor the ends to which it may be directed.

Thus we read of persons being "murdered by malignant spirits"; we are told of burning coals taken from an ordinary fire and laid upon the head of an elderly gentleman without even singeing his hair; of a "medium" becoming

alternately taller and shorter than his ordinary stature, the change being judged of not by sight alone, but by feeling; of living persons being conveyed through the air, and passed, without injury to themselves, through walls and floors; of gas-burners ceasing to give their ordinary light without any decrease in the apparent size of the flame; of rings being passed on to the arm of a person whilst his hand remained firmly clasped on the leg of a chair; of statues weeping; of hair embedded in a plaster-cast continuing to grow, &c., &c. Now we are on principle very reluctant to use the word "impossible." But if such things may and do happen, it seems to us that we live rather in Chaos than in Cosmos. The introduction of the arbitrary into many, perhaps all, classes of phenomena, is, to the scientific mind, craving everywhere for law and order,—a most painful notion. A new, or rather a hitherto unknown, agency or force not governed by any finite, personal intelligence, might, if discovered, compel us to re-write our text-books of physics or chemistry, or perhaps of biology. But its announcement would be far from unwelcome. We should know that in its manifestations there could be no caprice. We might rationally hope in time to discover its laws, its modes of action, its limits. With an agency or "force" governed by intelligence other than that of God—postulated as unvarying—or of living, visible man, the case is very different. So many variables are introduced into every question that its solution becomes impossible.

We cannot help noticing, with gloomy forebodings, that Spiritualism has greatly changed its character and its pretensions, and is undergoing still further changes. In its outset it was to give man a demonstration of the existence of God and of spirits generally; it was to assure him of his own continuance after death, and to afford him during life the means of intercourse with kindred and friends who have departed. Now it seems bent on the rehabilitation of much which has been for a century classed as mediæval superstition, and which was supposed to be buried for ever.

It may, perhaps, not be idle to enquire what some of the alleged Spiritualistic phenomena involve? Let us take the case of the growth of hair from plaster-casts, as it has been recently discussed by several correspondents of "Light." We may admit, for argument's sake, that the phenomenon has really taken place as described,—that there has been a true growth, demonstrated, or at least demonstrable, by measurement and weighing, and that the increment has been of the same nature as that which occurs with the hair

of the living man when still rooted in the skin of his chin or scalp. We may at once admit as a well-known fact—having, however, no bearing on the case—that "the nails and hair have been known to grow after death on some corpses." We may dismiss, as simply puerile, the hypothesis of Mr. Atkinson, that oil or pomatum which had been applied to the hair of the subject to keep the plaster from adhering may have caused the growth of the hair. Surely a mere dead fragment of an animal body devoid of all the appliances for assimilation cannot take up matter from without, and grow thereby, even if such matter contained—which pomatum does not—all the necessary constituents. But if this growth was caused by spirit-agency, then these spirits have succeeded in doing what has generally been considered possible to God alone, *i.e.*, giving life to lifeless matter, and enabling it to execute vital functions, *viz.*, assimilation and growth. It is surely a serious, if not positively alarming, supposition, that there exist unseen around us beings possessing such power, and left, so far as it appears, to exert it at their own discretion! If such beings exist, may they not quite as easily have created from time to time new animals, new plants, and new disease-germs, mocking thus alike our theories of original Divine creation and of Evolution?

It would be grossly unfair if we did not here notice a passage on this subject by "C. C. M.," in "Light" for January 26th. He asks, "But are we therefore, on the other hand, to escape from our difficulties by attributing all sorts of powers and agencies to 'spirits,' just as many now well-understood phenomena were formerly so 'explained' in unscientific ages? I think this tendency among Spiritualists is greatly to be deplored, and brings them into not unreasonable discredit." Here, therefore, we are brought again face to face with our former question, What is the orthodoxy of Spiritualism?

We come to the weeping statues. That on certain changes of weather, especially on the sudden breaking up of a long frost, statues, like many other articles of stone, wood, glass, &c., are found covered with a copious dew is known to everyone, and the cause must, we should hope, be familiar to the veriest dolt who ever "went up" for an examination. But has it ever been shown, on sufficient evidence, that such moisture issues from the eyes of a statue when all the remainder of the figure is dry? Has such liquid ever been analysed and proved to be identical with the tears secreted by man? Is every possibility of trickery

disproved? If all these questions can be answered in the affirmative, have we not then the formation of an organic secretion elaborated without the secreting organ and without the material from which it is elaborated? If this work is performed by some invisible intelligence—and we can scarcely conceive it to be due to any unsuspected natural agency—we have, again, evidence of a dreadful power. But the most serious case of this class is the reputed change of stature in a living man, effected, as is intimated, not by any innate power in the person of whom this is recorded, but by the intervention of the spirits. Whoever or whatever could produce such effects must be, humanly speaking, little less than almighty. Whence could come the material for enlarging the body of a living man? Blood, muscle, nerve-tissue, bone, &c., are not to be found anywhere stored up ready for use. Their synthesis from the elements, or from simpler combinations, is something not yet dreamt of even at Munich. And were the materials ready to hand, their intercalation into the living man must be a still more difficult task. All the world's ordinary experience would show that organised matter is elaborated only in organisms, and by them slowly and gradually. We do not see that any of these three cases involves the creation of matter; but if such instances are true the organic world, at least, seems a most painful sphere of disorder and lawlessness. It will not do to reply that all these phenomena may occur in virtue of other natural laws of which we have no knowledge. It will not do to taunt us with ignoring or denying facts because of their rarity. The point is here that will (other than the One) and law are at variance. If there are finite wills which can interfere in the course of Nature without employing material agencies, Science is impossible. The hypothesis that God may carry out his plans by the agency of these spirits leads us back to the personifying epoch of human thought, to the special genii and gods of the mythologies, to the elemental spirits of the Rosicrucians, and the Archeus of Helmont. Is this universe so poor an affair that it requires a god or a demon at every wheel and valve and lever?

The only way in which Spiritualism—supposing all its claims well founded—can be reconciled with Science is by showing the exact nature and the limits of the power of these spirits, and ascertaining under what circumstances they can and do interfere. If such limits can be determined and such circumstances ascertained we shall then be able to find the value, so to speak, of the unknown quantities which

have latterly obtruded themselves into our calculations, and to re-constitute a Science. If no such limits exist, or if they are undiscoverable, we do not see how any body of exact, co-ordinated knowledge can exist.

Be it well understood that we cannot refuse to accept truth, however unwelcome. If the "reign of law" never has existed, or having existed is giving way to the "reign of the arbitrary," the sooner we awake from our pleasing dreams the better.

In a recent number of "Light" we read the following significant words:—"Spiritualism . . . comes to scientists and tells them that there are other laws than those they recognise,—puts facts before them which mystify or are ignored until Science has learnt to *accept human testimony and human consciousness* as a part of the great revelation. The scorn with which sceptics have *hitherto treated human testimony* shall be unwrung (?), and law discovered in those realms hitherto dedicated to the imagination. . . . I may be in the minority. I can calmly wait and think of Socrates and Galileo!"

Passing over other portions of this utterance we must call attention to the words which we have italicised. Science does not reject human testimony save when it is incapable of verification. Is she henceforth to be less scrupulous? Is she to accept every assertion made without scrutiny, and thus to desert the method by which she has effected so much? The very procedure taught and followed by all the reformers of Science from Roger Bacon to Galileo was to look to things rather than words, and to depend upon observation and experiment in place of hearsay. For anyone who upholds testimony and consciousness—ever self-contradictory—as means of extending knowledge, to pose in the attitude of Galileo is, to say the least, singular. As for Socrates, even if the head and front of his offending was not, as many think, a vice not to be named, he has the demerit of turning human inquiry away from things to words, and of retarding the progress of truth for more than a thousand years.

V. CIRCULATING MUSEUM FOR EDUCATIONAL PURPOSES.

By Rev. H. H. Higgins.

At a meeting of the Liverpool School Board, held in December last, a communication was made from the Committee of the Library, Museum, and Gallery of Art, inquiring if the duplicate specimens in the Museum could be used for educational purposes in connection with the Liverpool School Board.

The scheme was cordially entertained by the Board, and subsequently a letter was received by Mr. Moore, Curator of the Public Museum, from W. Hewitt, B.Sc., Science Instructor, mentioning a number of natural-history specimens likely to prove very serviceable to teachers in giving object lessons.

My first impression was that a small series of natural-history objects might be given to each school; but this idea was relinquished, chiefly for two reasons :—

1. In case of many applications for collections being received, the specimens granted must necessarily be small and of inferior character.
2. The collections being of little value, and remaining without alterations or additions, would probably before very long become neglected and wasted.

These considerations turned my thoughts towards the establishment of a circulating museum, the practicability and utility of which form the subject of the following report:—

The peculiarity of the scheme may be said to be based upon the recognition of a capacity in the children educated in Board Schools to be interested and delighted with objects of beauty or skill with which they are unfamiliar. This capacity is shared by all ages and ranks. A crystal vase in a drawing-room at length attracts little admiration from its owner, but fills with enthusiasm a stranger guest. The failure, in schools, of series of objects which have been extensively made up and sold as collections, has arisen mainly from the large number and insignificant individuality of the specimens. In the case of a hundred children assembled in the gallery of a class-room it would be comparatively easy to rivet and

sustain their attention during a lesson on an object of fair size and striking form, combined with beauty of colour and texture, the like of which they have never seen before. A specimen of considerable excellence, say a mineral or a shell, will not only assist the teacher in firmly implanting the instruction he wishes to give on its geographical distribution, place in Nature, and economic applications, but the beautiful and uncommon thing itself, if sent amongst children to be handled with care, and felt, and looked at closely, will, I am firmly persuaded, exercise a good moral and refining influence on some of them. A piece of quartz as big as a walnut, or the shell of the *Helix aspersa* from any old garden-wall, would probably fail to serve the same purpose, not from any fault in the children or the teacher, but simply because it would not appeal to the same natural capacity for admiration, which would therefore be left unexercised.

Such are some of the considerations pointing to the establishment of a circulating museum. A method of circulation may to some extent be suggested by the kind of collection required:—

1. It should be strictly limited to a single department or group in natural history, order being the main feature in Nature.
2. It should not consist of many specimens, probably of not more than twenty. It is thought undesirable to continue the object lessons on one group for a longer period than two months, in which time fifteen or twenty specimens might be well illustrated, and application be made for another collection.
3. A central depôt would be required for the collections. If established at the Public Museum, the distribution would be arranged under the superintendence of the Curator, Mr. Moore, and the Science-teacher.
4. Receptacles, each with lock and key, would be required for the conveyance and preservation of the collections.

A beginning might be made with a few collections consisting of type specimens of very large departments in Nature:—1, vertebrate animals; 2, animals without bones; 3, plants; 4, fossils: 5, minerals. These groups include everything suitable for an object lesson, and must therefore always remain as the fundamental groups. But it may practically be found more convenient to start with a further division of some of them. Thus, from the vertebrated animals might be segregated a group of such as suckle their

young (*Mammalia*). The enormous series of boneless animals might form two groups, animals with jointed limbs (*Arthropoda*) being set apart from the rest. Metals and metallic ores might be divided from other minerals. A supplementary series might be added for advanced classes, consisting of such groups as anthropology, with its divisions ethnology and archæology. The teacher might be left to exercise his own discretion in giving a lesson from two or even more objects at a time,—points of difference or resemblance constituting almost the entire sum of our knowledge,—but the apt teacher will be careful to preserve as long as possible some unseen treat in store.

Where the teaching on the groups has been efficient, the sight of larger collections will be found indispensable. The Liverpool Museum is free to all during four days in the week; but to ensure the largest amount of advantage to classes from schools the visiting party, under the supervision of the teacher, should not consist of more than twenty scholars. The visit should be made, if possible, at a stated hour known to the Curator, but by no means on a closed day—Tuesday or Friday. The visit should be made not for the purpose of passing rapidly through the rooms, but to a particular part,—to some special table case, or, at the utmost, to two contiguous table cases; to the wall cases in some room, or half a room; or to some 20 or 25 feet of the cases in the gallery, the teacher and his class to remain in the selected department during the whole of their visit. If the visit be made under such conditions the officials of the Museum will be instructed to put up barricades to prevent the interruption of the teacher and his class by ordinary visitors. The teacher and his pupils will, in fact, have the selected department to themselves for any time not exceeding one hour. I may be permitted to urge that such visits, together with the necessary times for going and returning, should in every respect reckon as attendance in school.

The specimens recommended for object lessons are not costly rarities, but each should be good and perfect of its kind; 6 or 8 inches in length, where such a size is ordinary; not exceedingly fragile, yet all the better if requiring respect and care in being handled by the children. Such objects as the *Arthropoda*, bees, locusts, king-crabs, a stuffed bird, or the skeleton of a small vertebrate animal, &c., might be given for examination to the class, each enclosed in a glass-capped box. Teachers and children should be encouraged to bring to the object lesson specimens of their own for comparison with the type specimens, care being taken

to avoid the introduction of objects foreign to the group.

In conclusion, I am constrained to remark that the benefit of the whole scheme must rest upon the cheerful co-operation of the teachers, and that the circulating museum is commenced quite as hopefully in behalf of the teachers as in behalf of the children. The field is one which is likely to contribute something to cheer the hours and brighten the lives of all who are engaged in giving instruction. I do not affirm that the children are already taught too much; but with a confidence, which has never swerved, in the wisdom of my old master Pestalozzi, I suggest to School Boards, high and low, that the teaching is out of all proportion in excess of the training, the latter being with difficulty weighed in the scales of school examinations. The object of the circulating museum is not so much teaching as training; not so much the inculcation of facts as the illustration of the happiness to be obtained through habits of observation.

There is a time coming when the unity of Nature, of which Evolution is but one imperfect aspect, shall be assimilated by all cultivated minds; but at present Science is driving enthusiastic love of Nature out of the field. Private collections are failing in Liverpool and all around; and teaching is hard, and hardening in its results, except in a school of extravagant fancy, in which sober average people cannot take their degrees.

Such is the state of things in which Sir James Paget, only the other day, asserted the curative properties of "Recreation by Wonder," healthy spontaneous admiration, not waiting to learn the name of the artist before venturing to praise the picture, but free as the breaking of the woods into song in the dawn of a spring morning. Scarcity of original research, forsooth? Are there not in Nature countless fields for research, original enough for the millions that never have a chance to be recreated in them, whether they be the teachers or the taught, and reminding us of the promised harvest, when both he that soweth and he that reapeth, the teacher and the scholar, shall rejoice together.

VI. ON TECHNICAL EDUCATION.

By Robert Galloway, M.R.I.A.

[(Continued from page 92.)

IT was stated in the last article that unless the Science Section of the Department of Science and Art was thoroughly reformed it would strangle real scientific education in the future, as it had done in the past. That it has done so in the past has, I think, been made apparent in former articles; that it must continue to do so as long as the teacher's payment depends solely on the marks won by his pupils in the examinations is evident; for such a system of payment leaves the teacher no option,—he must *cram* his students to have a chance of earning a living. Yet every efficient teacher knows too well, as the Rector of Lincoln College, Oxford, has stated, "that this process—preparing pupils for examinations—is incompatible with genuine instruction in Letters and Science." The same high authority has also stated that the examination system was destroying education; and let it not be forgotten, in connection with this expression, that of all the examination systems at present in vogue in the United Kingdom, the Department's system is the very worst, for the teacher's payment depends solely on his pupils obtaining a certain number of marks each at the examination; if they do not obtain that number the teacher receives *no pay* for teaching them. Mr. Justice Fry, in an Address at the Salt School, Shipley, said "Knowledge is divine, but cram is a demon."

The Examiners under the City and Guilds of London Institute complain in their Reports that competent teachers are not to be met with; "this want therefore prevents the formation of technical classes in many places where such classes are greatly needed." It is evident from this that the Department's system has failed to furnish competent teachers for the courses of technical instruction promoted by the City Guilds. The Department's own examiners complain, as we have shown in former articles, of the *quality* of the teaching given in the Department's own Science Schools. Our manufacturers, and others interested in the cultivation and diffusion of sound Scientific and Technical Education, are also not satisfied with the results which have been obtained by the Department's system after its nearly

thirty years of operative existence; hence the constant demand for information, by means of Commissions and Reports, as to what is being accomplished on the Continent in these branches of instruction. In short, it is universally admitted that we are far behind continental countries in Scientific and Technical Education, and this after all the vast sums of public money that have year after year—for nearly thirty years—been placed in the hands of the permanent officials of the Department, to obtain results at least equal to those obtained in Germany and other countries, and which are obtained at a less cost than the inferior results obtained by the Department.

The question naturally arises in the mind, What is the cause of this lamentable educational failure? It is due to the system—payment on results—which our officials have forced on the country, and by the adoption of which we stand absolutely alone in the realm of education amongst all the civilised and semi-civilised nations of the earth, with the exception perhaps of China. Not alone is the system not adopted; it is condemned by other nations by the system—the very opposite of it—they follow. It is also condemned by every one in our own country who has the least pretension to be classed as an educationist; yet we as a nation continue this worthless and vicious system, whilst at the same time we are continually sending out Commissioners to report, and also publishing from other sources reports on the methods and results of the teaching in foreign countries. Why is such an unwise—one might almost add unpatriotic—course followed by our Statesmen and Senators when they find, as find they must if they give the subject any attention, that the *sole reason* why we are behind continental nations is that they adopt an enlightened system of education, whilst we adopt a worthless and vicious one. But whilst being a worse than worthless system, as an educational one, it is a most perfect and efficient one for bringing into and keeping in existence a very costly Bureaucratic Department; and most probably that explains why Parliament has never seen fit, or perhaps not been able, to reform it.

What would have been the condition of education in England if, from the days of King Alfred down to the end of Queen Elizabeth's reign, there had been established the payment on result system in place of the 245 public schools which were founded during that period, and military men had been made the Councillors-in-Chief to the Sovereign and the Ministers of the day who had charge of the education of the people. If that had occurred there would be no

Eton, Harrow, or any other of the great public schools at the present day for our aristocracy and the wealthier class to send their sons to, to be educated; all real education would have been crushed out of the land, and, as far as our ministers of education were concerned, we should be pretty much in the condition that China is at the present time. But the Rulers in England in those days were wiser as regards education than our Rulers appear to be at present; they, like the Rulers of other countries, sought out men distinguished as educationists, in our own and other countries, to advise and aid them in educational systems and projects, just as is done at the present day in Germany; for in that land of learning the custom is to associate, with the Minister of Public Instruction, men, as Councillors, who have had *large experience* in educational matters, and have given *evidence* of their administrative powers in that department. As examples of what was done in former times in securing the assistance of those renowned in the science and art of education, it may be mentioned that Alcuin, a Yorkshireman, was employed to organise the schools of Charlemagne. Sturm, who was called the schoolmaster of Germany, had a pension from the King of Denmark, another from the King of France, and a third from the Queen of England, for his educational labours, and his school-books were adopted by Ascham in England and by Buchanan in Scotland. That great and distinguished educationist of the day, John Amos Comenius, was summoned to England in 1641, by ORDER OF PARLIAMENT, to advise them on educational matters, and he would most probably have been appointed to some College to carry out his system of education, which had an important effect on Milton, but his visit to England was cut short by troubles arising in Ireland. His first great book on Education, the "Ianua Linguarum Reserata," or "Gate of Tongues Unlocked," immediately on its publication circulated throughout Europe; it was subsequently translated not only into Greek, Bohemian, Polish, Swedish, Belgian, English, French, Spanish, Italian, Hungarian, but also into Turkish, Arabic, Persian, and even Mongolic. In those days our Government, like other civilised Governments, sought for the best systems of education, for sound education was valued, and the educator was honoured and respected. The same cannot be said at the present day under the system of payment on results; the educator is not respected, he is treated as a menial, and his position is such that he can be deprived of his employment at a moment's notice by an irresponsible official by the mere stroke of his pen.

The necessity for our having a good system of Scientific and Technical Education is becoming more urgent every year; the commercial monopoly we possessed is departing from us; and if we do not adopt, and that speedily, a good system of Scientific Education, so as to provide our manufacturers and their managers with the knowledge and skill necessary for *progress* in scientific industry, other nations will outstrip us in the race. Germany, by reason of the excellent scientific education she provides for her sons, has taken the lead in the new industry—the manufacture of artificial dyes. Yet the raw products required for their manufacture are exported from England, and manufactured in Germany, and the manufactured article imported for use into England. It is estimated that the consumption in England of alizarin and the coal-tar dyes cannot be less in value than £1,000,000 per annum, and these are manufactured very largely, in fact principally, in Germany.

America, with her vast and varied natural resources, will become England's most dangerous competitor; she possesses in addition to all the raw materials we possess several others. The result is that, whilst the United States in 1880 produced 95 per cent of all the raw materials consumed in their factories, we imported 93 per cent of all that was consumed in ours.

There are likewise flocking to that country some of the most skilled workmen from the different European countries, taking with them a Technical Education and Skill in many different industries. Then, again, America and England commenced at opposite poles in manufacturing industry; they were deficient in human labour, we had an excess: hence the greater development of automatic machinery in the one country than in the other. The want of sufficient capital, which has hitherto held in check their industrial enterprise, is being rapidly supplied. It is estimated by American statists that the annual savings of the people amount to about 200 millions sterling.

In addition to the good school system they have established, they have likewise excellent colleges, where the students receive a good scientific education; and many of the students, after having finished their college course in their own educational institutions, take advantage of some of the German ones; or they visit the different European countries to see for themselves how various industries are carried on in the old world, before they commence as owners or managers of industrial factories in their own.

We need not again refer to our dependence on France for

designs for the calico-printing and other trades, as that subject was very fully dwelt upon in the article in the April number (vol. iv.)

Persons like myself, who have had practical experience in manufacturing industries and in teaching science, may point out in publications the grave defects in the Department's system; the public press may lend its aid; but in the end it rests with our statesmen either to reform this most expensive and worthless system, or allow it to continue. I took the liberty of directing the attention of some of our statesmen and senators to the subject a short time ago. From the communications I received from them, it would appear that many of them are not in favour of the system, but they do not see their way to substitute a more perfect one, which would enable Parliament to have at the same time such a complete, as they seem to think, control over the Expenditure. That control I look upon as purely imaginary. Certainly Sir Wm. Dunbar does not appear to think, if we are to judge from his remarks in some of his reports, that anyone has very much control over the permanent officials in its expenditure. I think if anyone devotes a little attention to the subject, he will come to the conclusion that it is unwise, even unconstitutional, to place such large sums of public money in the hands of officials, which, to a large extent, is based on probabilities, for the estimates are prepared in November, and the examinations, on which the result payment depends, are not held until the following May. It also tends, by having this large sum of money at their disposal, to make these officials tyrannical in their conduct to the teachers, and thus causes good men to leave the service, and prevents others from entering: cases like that about the employment of the "Darmstadt models" in teaching mechanical drawing might be cited as examples. But surely if the statesmen of other countries can establish good systems of education, and exercise at the same time full control over the expenditure, our statesmen ought to be equal to a like task; but then other countries do not put men in office who are *inexperienced* in educational matters, and who have given *no evidence* of their administrative powers in that department. To show that the control is to a great extent, if not altogether, a myth, it might be asked, were not the permanent officials uncontrolled in the expenditure of the £115,000 in connection with the Paris Exhibition of 1867? and where was the control when an accountant some years ago could abscond with public money to the extent of £7704 17s. 10d., which has never been recovered.

In place of the present system I would divide the United Kingdom into what might very properly be termed collegiate districts, and I would assign the *Inspection* and *Examination* of the Science Schools to the Professors of the College situated in each of the collegiate districts. We will first investigate the educational advantages this system would have over the present one, and afterwards compare the cost of the two, including the payment of the teachers.

By my plan not only would *Inspection* and *Examination* be combined, which is not the case at present, but the Inspection would be conducted by those who were engaged in the work of Education; whereas the Inspection is conducted under the present system by those who are not practically engaged in Education: it is mainly done by Officers in the Army. By the system proposed the examinations could be *entirely*, if desired, of a practical character, and the pupils would be examined of course as to "how they were taught, as well as what they were taught." It would prevent teachers from teaching any of the sciences of which they themselves had no experimental knowledge; in other words, it would banish mere book teaching, which prevails under the present system. Under the new system each of the pupils would be *separately superintended* and *instructed*, because each mind is different, and has different capacities, and the difficulties of understanding and coming to a knowledge of any subject vary with each individual mind. Individual instruction being adopted, the teacher would be able to teach students in different stages of advancement at the same time, as is done every day in chemical laboratories. There would be, under the system proposed, a plan and unity in the instruction given in the schools, which is entirely wanting, as has been shown, in former articles, under the present system, owing in a great measure to the plan of paying the teachers.

As the teachers would generally have less experience and extended knowledge of their subjects than the College Professors, great advantages would necessarily accrue from their coming into educational contact with the Professors. They would be able to apply to those more conversant with the subject of instruction in their difficulties; for suggestions as to improvements of the working processes; and the College Examiners would see with their own eyes, which is not as we have seen the case under the present system, whether the work of practical instruction was efficiently carried on. The colleges and schools would in many ways beneficially act on one another, and meritorious teachers in

the schools would certainly be recognised and stimulated in their work and advanced to higher positions; whereas under the present system they are left in a hopeless state of stagnation.

Another very important educational advantage which the proposed system would have over the Department's one, is that there would be diversity in the examinations. We should not then be casting all the young intellects in the science schools into the same mould, as is done at present by employing the same set of Examiners always, and for the whole of the Science Schools in the United Kingdom. Moreover, the teacher would be able to throw into his teaching more individuality and intelligence, and by diversity in the examinations we should not be pulling all these young science students "through holes of the same size, after the fashion of manufacturing wires." We are at the present time stamping these young intellects, as the Government does its sovereigns, with one uniform die, which is opposed to all sound educational principles, and obstructs progress in the Science and Art of Education.

In addition to the Collegiate Examiners the plan I propose includes a special Minister of Education and Councillors to advise him on educational matters; the Councillors would be men who had made themselves distinguished in the educational and scientific worlds; they would not be required to give their whole time to this duty; but the question about the Minister and Councillors will be more fully discussed in a future article.

Some of my readers will no doubt say that this scheme, if carried out, would cost the country some money. Certainly; and therefore I will give a few items from the estimates for the present financial year, which ends on the 31st of March, to enlighten those of my readers as to the cost of the present system:—

	1883-84.
Director of Science and Assistant-Secretary...	£1,200
Assistant-Director of Science	778
(This salary goes up to £850.)	
Official Examiner	400
Duty pay for Official Examiner	200
Assistant-Examiner	267
(The salary of this official goes up to £400.)	
Duty pay for Assistant-Examiner	100

The Official and Assistant-Examiner, whose duties I cannot make out, receive in addition to these sums from £1 1s.

to £17 17*s*., according to the number of evenings they are employed *assisting* at examinations.

Organising Teacher in Science, at £1 1*s*. per diem, or £2 2*s*. when delivering a Lecture...	£350

The following belong to the Art as well as the Science Division :—

Professional Examiners, paid by day and *for piecework*	£10,400
Inspectors of Schools	1,865
Occasional Inspectors at £2 2*s*. and £3 3*s*. per diem, and *Acting* Inspectors at £1 1*s*. per diem, and one Inspector who is also Lecturer in the Normal Science School at £750 a year	4,800
Lecturers paid by the Lecture, and grants in aid of the Instruction of Science Teachers at Provincial Colleges	500

Travelling :—

For General Administration, Schools of Science and Art, Circulation, Exhibitions, and Collections of Local Schools, and South Kensington, Bethnal Green, and India Museum	6,420
Temporary Clerks, Copyists, &c.	8,700

We will add one or more items in the Science division :—

Payment on Results Science Schools... ...	£49,500
Payments to Local Secretaries and Assistants	1,500
Payments to *Special* Local Secretaries and Assistants	1,800
Science grants and prizes	4,600

To give an entire list of the multifarious items would, I am afraid, make it unreadable to most people; but I think I have given sufficient to show that this worse than worthless system costs the country yearly a very large sum of money. If the system I propose was adopted, the items I have given, and many others, would be abolished, and the money that would be expended would be expended in a healthy manner. The teachers would be paid by capitation fees, and they would be encouraged to look to the fees of their pupils as a part of their salary; and good and efficient teachers would secure paying pupils if they were under a

system that allowed them to teach in the way they considered best; but as long as they can display no independence of thought in teaching, as is the case under the present system, but are obliged to walk and make their pupils walk in the paths of Science the Examiner lays down, pupils will not pay for the instruction.

The cost of the efficient inspection and examination I propose, the travelling expenses of the Examiners, the capitation fees of the Teachers, would not amount to the sum it costs at present for the *Permanent*, the *Occasional*, the *Acting* Inspectors, the Director and Assistant-Director of Science, the *Official* and *Professional* Examiners, the travelling expenses, and the sum paid for payment on results. And by employing Councillors to advise and aid the Minister of Education, an ordinary Secretary with a small staff of Clerks would only be required at South Kensington; hence another large saving, and to this would be added a large saving on stationery and printing.

It has been announced in the public press that the Evidence and Report the Technical Comissioners are about to issue will occupy five volumes: these may be issued, but if the present system remains unreformed they will be of no permanent benefit to the country. HOW AND WHERE WE FAIL is obvious to those who have given time and attention to the subject. It is at all events my object in writing these Articles to point out the cause of our failure.

(To be continued.)

ANALYSES OF BOOKS.

An Examination and Popular Exposition of the Hylo-Idealistic Philosophy. By W. Bell McTaggart (late Captain 14th Hussars). London: W. Stewart and Co.

We have here a small but exceedingly important work. The author undertakes to furnish a clear and summary exposition of the system of philosophy thought out by Dr. R. Lewins, and known as Hylo-Idealism. So far this system has not by any means received the attention to which it is fairly entitled. Time and place are unpropitious. The modern every-day mind—may we venture to say especially the normal English mind?—cares little about philosophies. Whether the phenomena which it recognises are merely sensation of its own, whether they have an underlying objective existence, whether such phenomena are faithful copies of noumena, if such exist, it cares little. The man of special science, like the man of business and the man of pleasure, is content, for the most part, to occupy himself with the phenomena, inquiring no further. Moreover, the religious world pays itself the doubtful compliment of avoiding and denouncing all such trains of thought as possibly "leading to infidelity."

The claim put forward on behalf of Dr. Lewins is, that he has originated "a complete and self-contained system of philosophy, sufficient in itself for all things, not alone as bringing about a reconciliation of that dualism of mind and matter which has been the stumbling-block to thinkers of all generations, but as giving a sufficient answer to the problems of the universe, and furnishing a rule and guide for life."

Claims no less high, the author admits, have been put forward on behalf of other systems which have, each in turn, been found wanting. He declares that "the persistent effort to abolish the antagonism between mind and matter, subject and object, ego and non-ego, and to unite the contending theses of Materialism and Idealism into one harmonious whole," is the distinguishing feature of the philosophic work of the present day. He holds also that Dr. Lewins is working on parallel lines with Mr. Herbert Spencer, whose Transfigured Realism is practically identical, up to a certain point, with Hylo-Idealism. Perhaps it would have been well if Mr. McTaggart had distinctly shown at what point the divergence between these two great thinkers begins,

and in what it consists. He says, indeed (p. 9), concerning the dogma of animal and human automatism :—"This conclusion, from which so many Materialists have shrunk, was boldly accepted by the late Professor Clifford, and I am compelled to confess that, on the lines of Transfigured Realism, I can see no other outcome." Mr. Spencer, indeed, has disavowed the doctrine of human automatism, and has promised to show in a future work how that issue is to be avoided. He says, however, as quoted in the work before us, "Crude Realism holds that space and time are objective realities, forms of things, known *à posteriori*. Transfigured Realism holds that space and time are forms of things which have become forms of thought through organised and inherited experience of things." According to Mr. McTaggart "Hylo-Idealism teaches that space and time are 'thinks,' sense-objects, arising from stimulus *plus* response to stimulus; and are therefore, *for us*, as much objects as tables, trees, or men." These considerations will, we trust, enable the candid—though perhaps not the captious—reader to seize the difference between Mr. Spencer and Dr. Lewins.

Dr. Lewins lays down as one of his fundamental propositions that "man is the measure of the universe *for man*," the two words which we italicise being a necessary corrective addition to the original formula of Protagoras. The fundamental, and by no means dissimilar, assumption of Transfigured Realism is that "all our knowledge is based upon and bounded by experience, and that outside or beyond himself man cannot go," with the saving clause that the term experience means not alone the experience of the individual, but the collective experience of the race, which supplies the so-called "necessary truths" of Kant and his followers.

We must now glance at the two conflicting systems which Dr. Lewins undertakes to reconcile. Materialism is here defined as that philosophy which constructs the universe in its widest sense, thought and emotion included, out of matter only. For spirit it consequently finds no room. It tells us that in the brain and out of it there is nothing but energy and matter. Hence "man being in every bodily tissue, in every desire, thought, and action, only the resultant of all the conditions of his environment animal automatism,—human automatism must result. Here, then, reasoning logically upon accepted facts, we come to a conclusion which the author holds to be subversive of all morality.

Unless then we would fall into Scepticism (using the word in its philosophic sense, and not as is done at the tea-tables), and believe that the truth is non-existent or undiscoverable, we turn to the Idealists. They tell us that "There is but one existence, mind. Analyse the concept matter, and you will discern that it is nothing but a synthesis of qualities (*Materie ist Eigenschaft*)—these qualities are sensations, and the synthesis is mental." But to what does this ultimately lead us? To abso-

lute egoism,—the assumption that all things are subjective within ourselves. "If nothing exists except my thoughts, then no other mind can exist beyond my thought of it. The ground we have for believing in the existence of other minds is not a whit stronger than the ground for believing in the existence of other bodies." Here, therefore, morality is again subverted.

How then are we to accept the evident element of truth in each of the two contending systems, and yet bid farewell to each in turn when it would lead us into the quagmire? The union between Idealism and Materialism is effected by our recognising "the relativity of the two: without subjectivity no objectivity; without objectivity no subjectivity. It is by the relation between them both that both exist." Elsewhere our author writes:—"The union consists in the recognition that subjectivity and objectivity are, as it were, reverses of the same medal; that subjectivity arises only from combinations and qualities of what must be regarded as the objective, namely matter; and that objectivity, in its turn, arises also from the combinations and qualities of matter which have produced a subjective organisation capable of perceiving and responding to the objective. Matter, matter, everywhere; but let me point out,—avoiding the difficulty of the crude Materialistic hypothesis, which denies the subjectivity of Matter,—Hylo-Idealism admits that the subjective does exist, but shows that it exists as a phase of, but not independently of, matter. This is the point, both of union and of divergence, between Hylo-Idealism and Materialism." On the other hand, turning to the side of agreement with pure Idealism, we find that in the sight of the Hylo-Idealist "the whole universe of things and thoughts is only an automorphosis, each ego being to itself, as Protagoras postulated the measure and standard of all existing things, of all thought and objects of thought whatsoever."

For the solution of the old difficulty of necessity and free will, as given in the words of Dr. Lewins, we must refer our readers to the work itself. Nor can we summarise, much less discuss, the train of reasoning in which Mr. McTaggart—referring to the possibility of space of four, five, six, and even *n* dimensions—contends that a point of contact between spirit and matter seems "more than probable." But we must call attention to the author's peroration:—"Matter is affected by spirit, spirit by matter. Their union is the 'think' of the Absolute. The material universe is this 'think,' and it has become a reality to the Absolute, just as much as space and time, trees and men are our 'thinks,' and have become realities to us. Beyond this we cannot go. What is matter, or what is spirit, we cannot know; and what their point of contact is we may not even imagine. The outcome of the universe, then, which is object to us, is the 'think' of the Absolute, not the Absolute itself. Under this luminous conception crude Materialism vanishes away like an

evil dream, for matter depends on spirit. Pure Idealism must bow its head, for spirit depends on matter."

In bespeaking the attention of our readers for this book, we admit that it cannot be hastily swallowed and despatched. Though extending to 84 pages only, it will require careful, deliberate reading. But we believe that every thoughtful man, even if he does not feel prepared, at the moment, to accept the system here set forth, will derive benefit from its study. The second and third appendix, the latter bearing the ominous title "Hylo-Idealism at the British Association," will prove wholesome reading for not a few of our scientific specialists, reminding them how sandy is the foundation upon which their hypotheses are built. We have always experienced a profound sadness when we reflect how little of our recognised Science is demonstrated, or even demonstrable. An emphatic reminder on this head will be salutary to many.

We dare not venture to say that Dr. Lewins will be promptly appreciated. Official science will have none of him. Independent thinkers are few, and relatively less powerful than was formerly the case. But in the future it will be held that if the mystery of the universe can be unlocked at all, he has supplied the key.

Original Essays. By S. Tolver Preston. London: Williams and Norgate.

The Essays herein contained discuss the social relations of the sexes, science and sectarian religion, the scientific basis of personal responsibility, and evolution in reference to female education. All these topics are discussed in the light, or at least in the spirit of the Evolutionist School.

A contemporary has recently taken occasion to regret what it styles the common "misapplication and abuse" of the principle of Evolution, "especially its application in the most illegitimate and unscientific way to the solution of questions in the domain of morals and religion, which lie completely beyond its province." This regret we by no means share. On the contrary, we hold that the principle of Evolution has been succcessfully applied to social and moral questions, among others by Mr. Tolver Preston, and has already led to valuable results which would not otherwise have been attainable."

The first of the essays before us deals with a question which has been systematically ignored. Says our author, very truthfully, "A thoughtful consideration of the whole subject may, perhaps, warrant the conclusion that man has advanced *less* in

knowledge as to the proper mode of viewing the true principles that should regulate the ethical feelings existing between the sexes, than in any other of those branches of knowledge which, in other respects, have raised him so far above the rest of the living world."

Mr. Preston then proceeds to plead for greater freedom in the relations between the sexes. He denounces the rigid Puritanism, absurd proprieties, and restraints of the present day, especially in England. He argues that "an unnatural system of coercive restraint aggravates the passions [why plural? would not 'appetite' be the better term?] to an inordinate degree, and is certain to be followed by excesses." This is scarcely to be doubted. Probably in no capital city does prostitution appear in a form so dangerous to society as in prudish London. "Puritanism," says our author, "may truly be said to be one of the worst vices, as it is the source of evils of the most injurious character." This is a bold assertion; but if we take a dispassionate review of the hindrance it has proved to Art, to Literature, and to Science even, and that those districts where it was most rampant are precisely those where to this day the lucrative vices most flourish, we shall not be able to refuse our assent.

But we, as a people, have been reared for generations under such a system of hard-and-fast regulations, imposed upon us not by any tyrant, but by ourselves, that their removal would be the signal for impropriety. On the Continent, *e.g.*, public gardens can exist without fences and gates. Were we to try the experiment our parks would quickly be ravaged and laid waste. Hence any relaxation of existing customs can be effected but gradually.

The second essay, "Science and Sectarian Religion, or a Personal Experience of the Evils of Religious Doctrine," bears the significant motto "Truth needs no sanctification," and is even bolder than the foregoing. A work which appeared a few years ago, under the title "The Unseen Universe," furnishes the author with his starting-point, though it is not formally reviewed. A prominent and startling idea is most distinctly conveyed in the following passage:—"According to the dogma of infinitely lasting punishment, the punishment for vice in this world would be *infinitely* inadequate, which is practically tantamount to teaching that the pursuit of vice must be infinitely profitable in this life." Mr. Preston made substantially the same statement in a paper on Natural "Science and Morality," which he communicated to the "Journal of Science" in 1880, and which will be found on p. 450. We do not find, however, that anyone has attempted its refutation.

On p. 27 we find a passage which may sadden or amuse the reader, according as he is of a Heraclitan or Democritan vein:—"I may mention here (for the sake of illustration) the modern 'Salvation Army' scheme, whose programme a well-known Review has recently lowered itself enough to publish." In a

note the author adds, "Could it be believed in any *civilized* country that a respectable journal would publish a programme like that of the 'Salvation Army'? This is an instance, I think, of the point so instructively brought forward by the late Mr. Darwin as to the peculiarities of the *flora* and *fauna* of *islands*. The *inhabitants* are of course included. Therefore this may account for the extraordinary anomalies and mixtures of the human mind that one finds in this country, great geniuses and great fools (if a too coarse expression be excused). What continental journal of the character of the Review alluded to would have published, among papers sometimes filled with the highest contributions to Science, the screamings of 'Hallelujah Bill' and of 'Salvation Sal,' as they have been aptly termed?" This is doubtless sad; but it is no less sad to see a journal which poses as the highest organ of Science—at least of official Science—in this country insert advertisements of life-pills and of "pick-me-ups"!

In a note on pp. 32, 33 we find a statement on which issue may be fairly joined. Says the author:—"But then every competent judge knows that what evidence there is points overwhelmingly *against* an eternal existence, especially the great principle of Evolution which correlates man with the rest of the living world, which are admitted *not* to have a future life, but to give up life at their decease." Mrs. Grundy doubtless makes this admission concerning the lower animals. Bishop Butler does not. For our part we cannot help feeling that the evidence for animal and for human immortality is identical. The two cases, in legal phrase, run on all fours together.

The third essay treats of the "Scientific Basis of Personal Responsibility, or the Mode of reconciling Personal Responsibility with the Principle of Strict Causation in Nature," and is a development of the author's paper in the "Journal of Science" for 1880, p. 457. Mr. Preston opens the discussion with an oft-mentioned difficulty:—"The criminal may retort 'My actions being the result of natural causes, why should I be punished for what I cannot help?'" John Stuart Mill is also quoted as saying, in like strain, "The Owenite invokes the admitted principle that it is unjust to punish anyone for what he cannot help." To us this difficulty, if any, seems to have been needlessly magnified. Not to mention that Society may reply to the criminal, "By the very same natural causes we cannot help hanging you!" there is a fallacy in the word "punishment." The first of our natural rights, that of existence, involves the right of eliminating if possible whatever attacks us, be it assassin, ruffian, tiger, wolf, cobra, disease-germ, flood, or conflagration. We do not punish the man-eating tiger; we eliminate it. We do not punish disease-germs; by drainage and disinfection we aim at their extirpation. Just in like manner with the assassin or the burglar: if the instinct of self-preservation is not dead within

us, we take care that when once recognised as such he shall not have the opportunity of repeating his offence, and especially of reproducing criminal descendants.

The author's proposal of inflicting penalties equal to the sum stolen, &c., multiplied by the chance of detection, might answer admirably for offences against property; but for crimes against the person—which our laws, with the single exception of wilful murder, punish more leniently—it would be utterly inadequate, and, like our present system of inflicting paltry fines for cases of ruffianism, would be merely adding insult to injury.

We have not the pleasure of agreeing with all the positions advanced by the author; but we must recognise this little work, as a whole, as a signal instance in favour of applying the principle of Evolution to the study of Sociology and Ethics.

Poisons: their Effects and Detection. A Manual for the Use of Analytical Chemists and Experts. With an Introductory Essay on the Growth of Modern Toxicology. By Alexander Wynter Blyth, M.R.C.S., F.C.S., &c. London: Charles Griffin and Co.

Without doubt we have here the most comprehensive and trustworthy book on Poisons which has thus far appeared in the English language.

In an introductory chapter on the "Old Poison Lore" the author expresses the not improbable surmise that "the first poison-knowledge was that of the septic poisons. Perchance the savage found that weapons soiled with the blood of former victims made wounds fatal: from this observation the next step would be that of experiment,—the arrow or spear would be steeped in all manner of offensive pastes, and smeared with the juices of plants which were deemed noxious; and as the effects were mysterious they would be ascribed to the supernatural powers, and covered with a veil of superstition."

From this traditional origin the history of poisons and poisoning is traced downwards with the aid of such fragmentary records as exist. It is stated that Attalus Phylometer, of Pergamus, was acquainted with Hyoscyamus, Aconite, Conium, and Veratrum, and that the Egyptians were acquainted with prussic acid, at least in a dilute state, as obtained from certain plants. There is, according to Duteil, in a papyrus preserved at the Louvre, the sentence "Pronounce not the name of I. A. O., under penalty of the peach!" implying that those who revealed the mysteries were put to death with peach-water. There is

little ground for doubting that the art of distillation was practised by the Egyptian priests. Indeed their knowledge, not only of Chemistry, but of Anatomy and Pathology, was assuredly far greater than is vulgarly supposed. The records of their lore perished, however, long before the reputed burning of the Alexandrian Library of the Arabs. No small portion of the guilt of this destruction must rest upon the early Christians (*see* Acts xix., 19), especially the monks, who played the same part in Egypt which they afterwards repeated in Mexico and Peru.

Nicander, of Colophon (204—138 B. C.), is said to have written on Snake-venoms, and on the properties of Opium, Henbane, certain Fungi, Colchicum, Aconite, and Conium.

On the subject of slow poisons which do not prove fatal until a considerable time after their introduction into the human system, Mr. Blyth holds an opinion which is scouted by many modern authors, but which we believe to be something more than a legend. A few cases of this kind have come to our knowledge. The writer remarks that certain malignant diseases answer precisely to the description of a poison which has no immediate effects, or which, in technical language, has its "time of incubation." The length of time that the poison of rabies can thus remain latent is well known, and there is at least no inherent impossibility that other poisons may be equally slow in developing their effects. Mr. Blyth says that the gipsies "have long possessed a knowledge of the properties of the curious *Mucor phycomyces*. They are said to have administered the spores of this fungus in warm water. In this way they (the spores) rapidly attach themselves to the mucous membranes of the throat, all the symptoms of phthisis follow, and death takes place in from two to three weeks."

The poisoners of the East not only select an agent which may in its effects simulate some natural disease, but, if practicable, one to which the intended victim might seem naturally liable.

The legend of Statira, poisoned by means of food cut with a knife, envenomed on one side only, has in it nothing impossible.

The great schools of poisoning which flourished in Venice and in the more southern parts of Italy from the fifteenth to the seventeenth centuries are ably described. There is here matter which might be welcome to the novelists of the day in their evident exhaustion of subjects and inventive power. At Venice the Council of Ten had their secret poisoners, who, for a due consideration, were ready to take in this manner the life of any potentate whom the Republic might consider dangerous. There was a regular tariff agreed on, increasing with the eminence of the victim, the length of the journey, and the difficulties and dangers to be encountered.

The "Natural Magic" of Baptista Porta contains many curious receipts for poisoning, and in the author's opinion the general tone of this treatise proves that Porta was no mere theorist, but had studied the matter experimentally.

The deadly nostrums used by Toffana and Keli, and afterwards imparted to M. de Sainte Croix and his paramour, the infamous Madame de Brinvilliers, seem to have been not mere arsenic, but to have contained a peculiar ptomaine, which, according to Selmi, is formed when animal matter decomposes in contact with arsenical solutions. One method of preparing such a poison, not mentioned in the text, was to dose a bear with arsenic, suspend him by his hind legs, and collect the liquid which issued from his mouth and nostrils during his death-struggles, or, as others say, during putrefaction.

In what may be called the practical part of the work Mr. Blyth discusses systematically the various known poisons, expounding their chemical nature, their mode of action, the symptoms preceding death, and the appearances presented on *post mortem* examination, as well as the most approved methods of separating such poisons from the contents of the stomach, the urine, the liver, brain, matter vomited, &c. Illustrative cases are also given, and—a very important feature—the attention of the expert is called to possible lines of defence and to questions likely to be raised by the opposite side.

Space will not permit us to do more than notice the section on animal poisons. Great merit belongs here to Mr. Blyth for the part he has taken in proving that snake-poisons are not ferments, capable of reproduction and multiplication in the blood or the tissues of the victim, but true, definite, chemical compounds, or mixtures of such compounds. As a matter of course germicide agents are utterly useless as antidotes. Dr. Shortt, as well as the author, had long ago found that potassium permanganate, recently recommended by Dr. Lacerda as an antidote, is ineffectual.

Concerning cantharides an interesting fact is brought prominently under notice. These insects may be eaten with impunity by the hedgehog, by fowls, turkeys, and frogs; but a man, a cat, or a dog may be poisoned by eating the flesh of animals which have thus fed upon cantharides.

The French "military surgeons in Algeria often meet with cystitis among the soldiers, caused by eating frogs in the months of May and June, the frogs living in these months almost exclusively on a species of cantharides."

In a case of poisoning by cantharides in any country where these or kindred insects occur, this fact would suggest a line of defence not merely plausible, but possibly well-founded.

The ptomaines are treated as fully and thoroughly as the present state of knowledge admits. None of these bodies, it is conceded, has been sufficiently studied. A needful caution is given against reliance upon the potassium ferrid-cyanide test.

Bleaching, Dyeing, and Calico-Printing, with Formulæ. London: J. and A. Churchill.

We have here a treatise on the three important and kindred arts of bleaching, dyeing, and calico-printing, compressed into the very brief space of 203 pages, the index being included. Under each of its leading sections we find a sketch of the history of the art,—which might, perhaps, have been better left to be dealt with in larger works, theoretical explanations, and practical procedures. The receipts, though necessarily very few in number, are taken from modern practice, and, as far as they go, may be safely followed. A few passages are open to be misunderstood. Thus on p. 63 we read—"The perrotine is employed in the French and Belgian factories, but not in the English, and effects a great saving of time and labour over hand-block printing; what required twenty men and twenty children, by this latter method being accomplished by the perrotine by one man and two children.

This is perfectly true, and yet to an outsider it is capable of conveying the false impression that hand-block printing is still in common use in England. The fact is that the great bulk of English printed calicoes are executed by means of the cylinder machine, which effects a still greater economy. We find the author saying—"In certain cases, such as in printing woollen and mousseline de laine goods, block-work has been very generally superseded by cylinder-printing." Now it is precisely in woollen-printing that the cylinder-machine is least satisfactory, and that blocking remains to a considerable extent in use.

In a note at the foot of p. 78 it is stated that Kopp first suggested the use of hyposulphite of *soda* as a mordant. We presume that this is a clerical or typographical error for "hyposulphite of *alumina*," which was proposed by Kopp in place of the acetate of alumina. Concerning the advantages, however, most practical authorities are sceptical, and it does not seem to have come into extended use.

We do not see any reference to aluminium sulphocyanide, now so largely used for alizarine steam reds in place of red liquor. In one receipt for an extract red it is mentioned along with red liquor.

We can scarcely enter into the spirit of those portions of the following passage which we have italicised:—"The discovery and application of the coal-tar colours have given an unprecedented impetus to this among other branches of calico-printing, not only by increasing the number and variety of tinctorial agents possessing purer tints, *but because the raw material for manufacturing them lies around us.* At the present day when the printer requires pale chintzes it is not necessary for him *to*

ransack the two hemispheres for the red, yellow, blue, green, and violet dye-stuffs, as it was not many years back."

The "raw material" for manufacturing tinctorial agents undoubtedly "lies around us," but unfortunately it is not manufactured around us. It is sent abroad to be manufactured by alien capital, skill, and labour, and comes back to us at prices which play into the hands of our industrial rivals. The "ransacking the two hemispheres" was to a great extent simply importing dye-wares from the colonies to the profit of our countrymen and fellow-subjects.

The section on dye-wares contains some errors not easily accounted for. Thus Brazil wood is described as identical with camwood! The names adopted for the dye-wares and chemicals are in many instances different from those in use, in dye- and print-works, with which the technological student should make himself familiar. Typographical errors are rather numerous. In reading over the index we come, *e.g.*, upon the "ferrocyanide of *tar*"—a gruesome compound.

As a whole, however, this little work deserves commendation, and in the probable case of a second edition it may be easily freed from its defects.

On Life and its Lessons. Being the Inaugural Address delivered to the Bristol Medico-Chirurgical Society in the Session 1882-3. By JAMES GEORGE DAVEY, M.D. Bristol: Fawn and Son.

THIS Address bears the aspect of a controversial manifesto. The author sets out with the dictum of Pope, "The proper study of mankind is man," to which, for men of Science other than physicians, we must demur *in toto*. After referring to the lectures of Lawrence on Man, Dr. Davey contends that there are in our days "men of mark and taking rank as physiologists who are using their best endeavours to stamp out the materialistic views of the new school of thought, and to replace them with the metaphysical and old-fashioned theories of early and ignorant times. The controversialists insist on enveloping their studies in so dense a cloud of assumption and mysticism that truth is nowhere to be found. Their reason is beclouded with a wild imagination,—and so it is they are lost in their delusions,—and, like the many recognised as *crazed*, are really objects of our compassion and sympathy."

Among these writers the foremost place is assigned to Dr. W. B. Carpenter, who is in substance, though not in so many words, accused of being swayed by "dominant ideas"!

It appears that the learned and voluble doctor communicated to the "Modern Review," in 1880, an article with the title "On the Forces behind Nature." Whether any such forces exist must, of course, depend upon the connotation which we give to the term "Nature." But what was the head and front of the offending of his old enemies the Spiritualists, save that they admit forces other than those commonly recognised as natural? How are the mighty fallen! If there are forces (? energies), personal or impersonal, behind Nature, which we here neither affirm nor deny, they must be either regular or capricious in their action. If regular, they may and should be studied. If capricious, Science becomes impossible, and Dr. Carpenter's avocation is gone.

Dr. Winn, following on the same side, denounces Professor Tyndall,—who as a correspondent shows is no Materialist,—*ore rotundo*. He tells us that "all unverified theories must tend to subvert the fundamental principles on which our morality and polity are based." Most theories have no bearing upon our morality at all which, moreover, can alter its bases without altering its code.

Further, Dr. Winn pronounces Prof. Tyndall to be "the subject of unbelief in what is true," and devoid "of a due faith in whatever is good and profitable to humanity." Can Dr. Winn make good these charges? If not, may they not possibly "subvert" his own morality and that of his readers?

Dr. Barclay—another writer of the same school—is said to "censure J. S. Mill for teaching that all the laws of Nature are unfailing, and, furthermore, for stating that this fact must form the major-premiss in every argument on such obscure subjects as the origin of life, of generation, of development, decay, and death."

Now here we regret that we cannot absolutely agree with Dr. Davey. Our laws of Nature—so-called—are the results of induction, and our inductions are never quite complete. Hence we are not warranted in pronouncing any event impossible, though we are fully justified in applying the most severe scrutiny to whatever deviates from the sum total of authentically recorded experience. Should anyone tell us that he has discovered in New Guinea, or in the interior of Africa, a warm-blooded animal, a mammal, provided with three pairs of limbs, we should be justified in examining the narrative of the discoverer very closely, and even in suspending judgment until a specimen of the creature had been examined by some competent authority and proved to be not a monstrosity, but a normally developed being. But we should not be justified, as some persons of eminence do, in ignoring the evidence offered.

On the other hand, it seems to us that if natural phenomena are controlled by will,—or at least by any will save that of a Being *ex hypothesi* immutable,—then all Science is impossible.

The suggestions which the author throws out as to the progressive elevation of the human race are sound in principle. But are they likely to be carried into effect? Is not the constitution of modern society such that the survival of the fittest is not in any way the survival of the noblest? The industrial, commercial organisation of the present is little, if any, more laudable and satisfactory than the military organisation of the past.

The Symposium: Durban Institute Magazine. January, 1884. Durban (Natal): Davis and Sons.

It is odd that this little miscellany should open with a ghost-story,—curious enough in its way, but one which thirty years ago would have been "declined with thanks" by any editor in the civilised world.

"Snake-Gossip," by W. Y. Campbell, is an interesting paper. The author states that there are in Natal twenty species of vipers (venomous serpents?), three of which are common to Europe, one to Australia, and the rest to Asia and Africa. Three of the species he describes particularly. The puff-adder, or Ibululu of the natives, seems to be identical with the *Daboaia Russelli* of India—a dangerous species. Contrary to the sweeping dictum of Charles Waterton, this species on the approach of man does not glide away, but holds his ground, and if trodden upon, or approached within a few inches, he bites. Old withered grass and stony places are his favourite habitat. The smaller puff-adder, or Inshlangwane, *Echis carinata*, is also found among tufts of dry grass and the roots of old hedges. The night-adder (Enshlangu) is identified by the author with *Bungaris fasciatus* of Fayrer. This serpent is of nocturnal habits, in shape like a "three-square" file, and is harmless if unmolested.

The English Illustrated Magazine. London: Macmillan and Co.

Among the articles in the issue before us is one on the Post-Office, which suggests to us two of the defects which still linger in our otherwise admirable postal-system. Why should monthly and quarterly journals not enjoy the same privileges as newspapers, instead of, as at present, being charged with a postage

which in some cases may amount to 33 per cent of their selling-price? Secondly, why should post-masters be empowered to keep back copy and proofs, passing per book-post between editors authors, and printers, until the next mail?

The "Character of Dogs" is a sign of the times. What shall we say to the following eruption?—"Yet more idle, and if possible more unintelligent, has been the attitude of his express detractors: those who are very fond of dogs, 'but in their proper place'; who say 'Poo' fellow, poo' fellow,' and are themselves far poorer; who whet the knife of the vivisectionist, or heat his oven (!); who are not ashamed to admire 'the creature's instinct,' and, flying far beyond folly, have dared to resuscitate the theory of animal machines."

We are not fond of dogs in *any* place; we do not say "Poo' fellow," nor do we accept the doctrine of "instinct"—in the conventional sense of the term. Neither are we converts to the theory of automatism, which if applicable to the lower animals must be extended to man also. But what of those who do not scruple to reproduce, in passing, the exaggerations and the perversions of the anti-vivisectionist? They, we fear, are the poorest of all!

The following passage, however, is worth thinking over with care:—"It is beyond a doubt to me that, somehow or other, the dog connects together, or confounds, the uneasiness of sickness and the consciousness of guilt. To the pains of the body he often adds the tortures of the conscience, and at these times his haggard protestations form, in regard to the human death-bed, a dreadful parody or parallel." We have heard it suggested that some of the higher animals have "a dim perception of the last great change," and with Mr. Romanes (*see* "Journal of Science," 1876, p. 145) we hold that they evince some rudiments of a moral sense. But the author of the article before us has gone so far that it would be interesting to know upon what facts his opinion is founded.

"The Humming Bird's Relatives" is a clever, dashing paper, in which a small portion of scientific truth is displayed to the best advantage, much as the author once remarked concerning the colouration of the "morning glory."

Longman's Magazine. No. XVI. February, 1884. London: Longmans and Co.

THIS number contains nothing which falls within our competence.

The Asclepiad, a Book of Original Research and Observation in the Science, Art, and Literature of Medicine. Vol. I., No. 1. January, 1884. By B. W. Richardson, M.D., F.R.S. London: Eade and Caulfield.

By far the greater part of this work concerns the medical practitioner only, and appeals as little to non-professional men of Science as to the lay public.

The first of the essays here placed before us gives an interesting account of the subcutaneous use of morphia, now becoming increasingly common. The author considers that "alcohol, acting like an additional worry and wearer of life, is an important secondary agent in the production of the opium *habitué*. This may be so, but we should conclude that the primary agent is the increased over-work and worry characteristic of the latter half of the century, and which is a phenomenon perfectly without precedent in the history of the human race. The author mentions the case of a medical man who, in the space of three years, had injected into himself 6000 grains, sometimes using 12 grains daily.

"Harvey after Death" is an account of the re-interment of the illustrious Harvey, which took place at Hempstead, in Essex, on the 17th of October last.

The concluding essay, "Felicity as a Sanitary Research," opens up some of the gravest questions. Dr. Richardson asks—"Can we honestly believe that these triumphs of ours which have so far ended in a certain victory over death have introduced any great triumph over misery? Have we by our labours made men, women, and children greatly happier as well as longer lived?" He adds, very truthfully, "These questions are momentous, because, if we are aiding in the act of adding to length of life and in developing population without giving to an extended and universal life Felicity, we may, in the long run, be working evil rather than good for the human race. . . . Surveying the questions I have submitted, I do not think that we have, so far, done very much to add to human felicity."

This is very nearly the same ground which we have taken from time to time. Sanitarians have been very anxious to root out smallpox and typhoid fever, cholera and diphtheria. But what have they done to counteract insanity, paralysis, diseases of the heart, and, in short, chronic debility in every form? Have they diminished or rather intensified the "struggle for existence," which more and more compels a man to employ his whole energies in the mere earning a livelihood, so that, as the "Spectator" puts it, the class, at least, which depends on brain-work is "harassed as it never was harassed before"? We fully admit that were the struggle for existence entirely abolished the

majority of men would sink down into apathy, and undergo a relapse into savagery. But there is a measure, a *via media*, in all the agencies which affect life. There are certain limits between which life is worth living, and, as far as work and competition are concerned, we have already touched, if not overstepped, the maximum.

We are extremely glad to find a sanitary reformer of such merit and influence as Dr. Richardson turning his thoughts in the direction shown in the present essay. We rejoice to hear him say—" Inasmuch as felicity is impossible under mental strain, it is fatal work to press on the young mind the excessive labour which is now in all departments making cram, cram the footing for knowledge.

We should like to see this paper, " Felicity as a Sanitary Research," circulated literally by the million.

Botanical Micro-Chemistry: an Introduction to the Study of Vegetable Histology, prepared for the Use of Students. By V. A. POULSEN. Translated with the assistance of the author, and considerably enlarged, by WILLIAM TRELEASE, Professor in the University of Wisconsin. Boston: Cassino and Co. London: Trübner and Co.

MICRO-CHEMISTRY has now become an important method of research. The student of Histology, vegetable or animal, no longer finds it sufficient to examine tissues, fluids, &c., under the microscope, even with the aid of the polariscope and spectroscope. He finds it necessary to treat his objects with certain chemical reagents, and to note the changes of texture or of colour thus produced. By this method the resources of the microscope have been, we may say, indefinitely enlarged, and the conclusions reached by its aid are rendered much more decisive.

The author of the little treatise before us confines his attention to vegetable histology, but much of what he says is applicable also in the minute study of animal matter.

The first portion of the work is devoted to an account of the reagents used, the manner of their application, and the results which they may be expected to produce. The colouring agents which have been successfully employed for the differentiation of the tissue-systems, and for the recognition of some of the cell-contents, are clearly described. We find it, however, singular that " fuchsine " and " magenta " are spoken of as two distinct colours. The former is simply the Franco-German name for the

latter. An Appendix to this section treats of media for mounting and of cements.

The second chapter describes, *seriatim*, the chief vegetable substances and the methods for their recognition. The entire work, within its very limited compass, is excellent, and will be found a safe guide to the student in vegetable physiology.

Longman's Magazine. No. XVII. March, 1884.

THE only article in this ably conducted magazine which we feel competent to notice is one entitled "Queer Fishes." It gives a popular and sketchy, but not the less essentially accurate, account of some of the strangest developments of fish life,—of venomous fish, blind fish, fish that travel on land and are even said to climb trees. The only queer fish omitted is the marksman-fish, which, so to speak, shoots flies sitting on waterside plants by projecting at them a drop of water.

Many important works stand over for want of space.

CORRESPONDENCE.

. The Editor does not hold himself responsible for statements of facts or opinions expressed in Correspondence, or in Articles bearing the signature of their respective authors.

ON CYCLING.

In reviewing Dr. Richardson you say that the cyclist moves too fast for close observation of Nature. I partly admit this; but an hour's cycling through 10 miles yields far more observation than an hour's walk through 3 miles, and you overlook the *silence* with which the cyclist approaches animals. For years I tried to see a corn crake, and never succeeded till a tricycle enabled me to surprise one by a roadside. The bicycle has enabled me to observe a weasel hunting by a hedgeside, and to get within 20 yards of it. I have heard the nightjar only during bicycle rambles, and never saw one except when I was cycling near Stratford-on-Avon. The only wild swan that I ever saw flew overhead while I was cycling at Papplewick, near Newstead. I noticed great improvement in the woodland paintings of Alfred Cox when he took to bicycling, to say nothing of improvement in his shape—from more than 16 stones to less than 14.

Let me, as President of the Nottingham Bicycle Club, join in commending cycles to all lovers of Nature.

Hugh Browne.

CANAL CUTTING.

In No. 155 of the "Edinburgh Review" is a very able article on schemes for cutting the Isthmus of Panama, and it treats as a great difficulty the excessive rainfall—more than 120 inches—in the district of Chagres, through which M. Lesseps projects a canal. Ought it not to be the greatest help? The Reviewer implies that all excavation must be done with the spade, but Californian miners have shown that water is far more effective; they conduct it along hill-sides at great expense, and then they direct it through the pipe of a *monitor*, with a force fatal to any man who gets in its way, and rocks and gravel break and disappear before it. With it one man does the work of fifty with

spades, and it work night and day without stop. The abundant water of the Isthmus seems the very means required for cutting it; and, unless I am mistaken, the monitor is equally capable of dredging and deepening a canal wherever there is stream to carry off the *débris* which it makes. It is possible that a hilly district, with copious water, may be easier to cut than a dry plain of sand.

HUGH BROWNE.

THE SCIENCE-TEACHERS AND THEIR POSITION.

PROFESSOR GALLOWAY, in his able articles on Technical Education, has shown by the testimony of the official examiners ("Journal of Science," 1883, pp. 542, 543) that Science-teaching in this country is unsatisfactory. But can anyone fail to see the why and the wherefore? So long as the system of payment by "results"—so called—obtains, so long the teacher can only earn his modest remuneration by training his pupils not "to know, but to pass." Most of us would prefer to give *bona fide* practical instruction, but the "Deparment" will not allow us. It was an evil day for scientific education in this country when Sir Lyon Playfair was eliminated from the Secretaryship and his place was taken by Colonel Donnelly.

SCIENCE-TEACHER.

THE SCIENCE AND ART DEPARTMENT.

THE thanks of the Science-teachers of this country are due to your contributor Mr. R. Galloway for his able and unanswerable impeachment of the Science and Art Department. In common with not a few of my colleagues I hope that the eyes of the public may be opened to the shortcomings of a system which effects little save waste of public money, and aims more at bureaucratic power than at the scientific education of the nation. It is truly sad that eminent men whose own published words condemn the Department should yet lend it their influence and the weight of their names.

CHEMICUS.

[We have received several more letters similar to the above.]

SQUIRRELS' NESTS.

I HAVE just got my copy of the "Journal of Science" for February, and I see in the Correspondence an interesting note about Squirrels.

On Friday last, February 8th, when two friends and myself were searching for traces of ice-action on the hard quartzites that form steep cliffs on the north side of the Vale of Pluscarden, in the county of Elgin, and near the ruins of the Priory, we found a squirrel's nest in a juniper bush about 4 feet high. The bush at the top is very dense, and the nest beautifully formed of the mosses that grow around, interwoven with twigs of the tall bare larches that flourish on the *talus* below, and, on the steep slope above the ledge where the juniper grows, cannot be seen unless one be looking very closely into the bush. While I was examining the nest and feeling for the entrance the squirrel darted out, leaped down 8 or 10 feet to the top of the *talus*, and mounted the nearest larch. A nest on any of the surrounding larches would have been too easily seen, and would not have been so secure and *cosy* as one in the low juniper.

JAMES LINN.

Geological Survey, Keith, Banffshire.
14th February, 1884.

NOTICES TO CERTAIN CORRESPONDENTS

Particulars concerning insects and their larvæ in the human body may be found in the "Transactions of the Entomological Society" for 1840, vol. ii., pp. 256 to 271.

Mr. Fahie's work on the discoveries of E. Davy in electro-telegraphy was noticed in our issue for October, 1883.

A paragraph on the alleged presence of hydrogen peroxide in the atmosphere of Italy, and its supposed effects on the human voice, appeared in our February number. We cannot, under any ordinary circumstances, insert matter sent us in slip which has been "going the round of the press."

NOTES.

THE Colorado beetle (*Doryphora decemlineata*) has been found by J. D. Forbes ("Amer. Journ. Pharmacy") to contain a vesicating principle. Whether it is identical with cantharidine is not decided.

Dr. P. H. Clarke ("Detroit Lancet"), after studying the determination of sex in offspring, concludes that the union of the sperm and germ-cells is a complete union, molecule by molecule. Sex is a condition of external force engrafted subsequent to the union of the cells, this force depending upon nutrition and other conditions independent of sexual potence. An important source of sexual determination is nutritive.

According to Högbom (Acta Reg. Societ. Scient. Upsala) the advantage of an insular and the disadvantage of a continental climate is more marked in autumn than in spring.

Herr Keller ("Schweiz. Gesell. Naturwissenschaft"), studying the interchange of animal forms between the Red Sea and the Mediterranean by way of the Suez Canal, remarks that the mollusks form the main contingent of emigrants, worms, crustaceans, and fish hold a middle rank, whilst the echinoderms and cœlenterates are little disposed to wander. Pelagic forms are of course excluded from this way of emigration. No littoral cephalopods have been found to travel by this route.

According to Col. H. C. Tanner the Indus between Bowanji and the Darel district flows at the bottom of a ravine 17,000 feet in actual depth.

The "American Naturalist," in noticing a memoir of Dr. H. A. Hagen, considers that the North American species of *Colias* may be reduced to three,—*Eurydice*, *Cæsonia*, and *Chrysotheme*,—with perhaps thirty local and seasonal varieties.

A certain Prof. Johnson, residing at Ontario, maintains that "the interior of the earth is a vast mass of electricity in one portion, and a great sea of fire in another. Before fifty years these two will come together, and there will be an awful collision."

A Japanese, Isac Tijima, has received the gold medal offered by the University of Leipsic for the best original work on the embryology of fresh-water planarians.

According to S. L. Ricciardi plants growing on the lava-soils of Etna contain appreciable quantities of vanadium.

"Les Mondes" recommends the leaves of rhubarb to be eaten in spring along with sorrel,—oxalic acid seasoned with oxalic acid.

According to the "Indiana Pharmacist" Dr. R. R. Gregg, of Buffalo, asserts that all the bacteria of disease are merely forms of fibrine.

According to Dr. Sutton ("Lancet") the majority of the monkeys in the Zoological Gardens die of bronchitis or of pneumonia. Only about 4 per cent of the deaths are due to phthisis.

At the January meeting of the Geological Society Mr. Blanford raised the question whether the Red Sea was older or newer than the Desert sandstone? Mr. Doughty mentioned that volcanoes had been active near Medina as late as the twelfth century.

M. Ballo (Ungar. Akad. der Wissenschaft) contends that one function of the roots of plants is to convert inorganic nutriment into the simpler organic compounds by a process of reduction. Chlorophyll may be regarded as a thermo-electric battery which converts the heat and light-rays into a galvanic current, and ultimately into chemical work.

According to a writer in "Light" the "Mahdi in the Soudan is no false prophet, but a pure medium, and the movement he leads will be the means of bringing about a universal church and brotherhood."

Dr. Wyld, in the same paper, writes:—"The rotatory force of our planet may be maintained, I would suggest, by the sun's rays striking her at a tangent due, perhaps, in part to the planet being eight minutes in advance of the propulsive rays of the sun.

On February 5th Mr. R. F. Conder read a most important paper, on "Speed on Canals," before the Institution of Civil Engineers. He explained the defects in the construction of the Suez Canal, and showed that by a scientific construction and the application of steam-power a normal speed of 5 miles per hour (equal to the through average rate of mineral trains) might be maintained on our inland water-ways.

According to O. E. Randall ("Popular Science Monthly") the birth-rate in New England families has steadily decreased since the extensive establishment of manufactures.

Prof. Struve, in a conversation with Prof. Piazzi Smyth, is said to have maintained that "the first boys at school disappear in the colleges, and those who are first in the colleges disappear in the world."

The upholders of the vested rights of syphilis have held a great demonstration in Exeter Hall.

Dr. F. Hulwa ("Gesundheits-Ingenieur") proves that the water of the Oder, after receiving the sewage of Breslau, is purified by the oxygen of the atmosphere and the action of vegetation. Fourteen kilometres below Breslau the sewage matters can neither be detected chemically nor microscopically, and the water was of the same quality as above the town.

Dr. E. von Raumer shows that the special function of lime in vegetation is the elaboration of material for increasing and strengthening the cell-walls. Magnesia, on the other hand, mediates the transportation of starch, and subserves the formation of chlorophyll.

Mr. J. Gunn, F.G.S. ("Geological Magazine") contends that the levelling of mountain ranges may be the cause of warmth of climate, just as their elevation is productive of cold.

Certain experiments made by Prof. Bunge ("Zeitschrift Phys-Chemie") upon Entozoa tend to show that the sources of muscular power in animals do not exclusively reside in the process of oxidation, but in the decompositions which take place in their food. Hence the less body-heat is required, the less is the need for oxygen.

Respecting the resolution of diatom markings Professor Abbe writes:—"All speculations as to the true structure of even *Pleurosigma angulatum*, so far as they depend on microscopic vision, are mere phantoms, castles in the air. No human eye has ever seen, or ever will see, the complete diffraction-spectra arising from a structure of this minuteness, nor will any microscope ever show an enlarged copy of it, so long as the spectra cannot be observed in a medium of at least 5·0 refractive index and by an objective of 5·0 numerical aperture,* which, as far as our present knowledge goes, is an impossibility. The microscopes of the present day admit relatively a small central portion of the whole diffraction-spectrum of the valve,—*i.e.*, the incident beam and the six spectra of the inner circle. But this portion is also yielded by a multitude of other objects which are endowed with an alternation of superficial or internal molecular structures which cross each other in two differeat directions at an angle of 60°. Such structures may be formed in various widely different ways; it may be by rows of spherules or other prominences of any shape whatever; rows of internal vacuoles of any figure, or the mere internal alternations of molecular aggregations within a perfectly transparent and smooth silica film. And yet all these yield with central light the identical circular field of the *angulatum* valve, even to the most minute particular. But although these spectra are identical as far as the six inner spectral beams are

* Half the sine of the angle of aperture multiplied by the index of refraction of the medium in which the object is viewed.

concerned, they may be vastly different in regard to some or all of the more widely diffracted pencils which are not admitted by the objective."

Of the ordinary members of the French Academy of Sciences two only have not received the "Legion of Honour."

Sir Joseph Fayrer considers the idea of finding a physiological antidote for snake-poison a Utopia. He maintains that venomous properties are communicated to the blood of the animal bitten, and that these properties are reproduced through a series of three successive animals. He doubts the alleged innocuity of the poison when introduced into the stomach.

According to M. Levallois solutions of cellulose in Schweitzer's reagent deflect the plane of polarisation to the left.

M. Wosnessenski ("Comptes Rendus") finds that the bacillus of anthrax developes well at 35° C., under the pressure of 3, 5, 6, 10, and 13 atmospheres. At higher pressures their development is arrested.

An attempt was made by the Bestiarians of Oxford to reverse the vote of £10,000 for erecting and furnishing a physiological laboratory. The most disgraceful means, "not stopping short at direct falsehood,"—as the "Medical Press and Circular" informs us,—were resorted to. But in the end Science triumphed by a decided majority.

According to M. Grimaux ("Comptes Rendus") mineral colloids approximate closely to the nitrogenous colloids of the organism; the retardation of the coagulation of ferric hydrate by a reduction of temperature is observed equally in the spontaneous coagulation of blood.

Snow which fell near Stockholm in December last was, according to M. Nordenskiold ("Comptes Rendus"), mixed with a black dust, consisting of carbon, iron, silica, phosphorus, cobalt, and nickel.

M. Haas ("Comptes Rendus") records that in Venezuela, September 2nd last, the sun at rising in a cloudless sky was of a beautiful blue. At noon its light was still bluish. At setting there were around its disc numerous horizontal rays of a deep blue on a pale blue ground. After the sun had entirely disappeared there was a fiery red glow in the sky which lasted until nearly 8 p.m.

Prof. F. Hoppe-Seyler ("Zeitschr. Physiolog. Chemie") pronounces the assumption of *Schizomycetes*, which can live only in the absence of oxygen, highly improbable, and certainly not demonstrated.

We are happy to find that the German Minister of Public Instruction has given his opinion against any restrictions on physiological experimentation.

Dr. Moffatt's theory of the influence of hydrogen peroxide in the air, and due in Italy as giving beauty to the voice, has been strongly combatted by Mr. Lennox Browne, who denies that hydrogen peroxide is more abundant in the air of Italy than of other countries.

Mr. Justice Stephen has formally ruled that the cremation of a dead body is not an offence at law, and can become so only if performed in such a manner as to become a public nuisance.

Mr. "Stuart Cumberland's" experimental performances at Edinburgh and Glasgow are being not unfavourably noticed in medical papers.

We regret to announce the death of the distinguished electrician Count Theodore du Moncel, editor of "La Lumière Electrique."

We are glad to find that Irish papers, of the most opposite shades of opinion, are noticing with approval the articles of our esteemed friend and contributor Prof. R. Galloway, on "Technical Education." We believe that if Science, in these realms, is ever freed from the yoke of bureaucracy, to Ireland will belong the greater share of the honour.

Prof. Jos. Rumpf (Acad. of Sciences, Vienna) has discovered a crystalline felspar—andesite—in lignite.

A meeting, presided over by Lord Stanley, of Alderley, at Bradford, adopted a resolution protesting against the system of payment by results in elementary schools, and urging that home lessons should not be compulsory on children under 10 years of age.

According to the "Electrical Review" even Philip Reis was not the first inventor of the telephone, having been anticipated by Antonia Mencci (1849) and Charles Bourseul (1857).

According to Dr. Gruber ("Zeitschrift für Biologie") all the nitrogen taken into the animal system is eliminated in the urine and the dung. There is no escape of gaseous nitrogen.

The observations of Mr. M. W. Harrington ("American Journal of Science") show that Vesta is in all probability a body like the moon, devoid of water and of a perceptible atmosphere.

TWENTY-FIRST YEAR OF PUBLICATION.

THE

JOURNAL OF SCIENCE,

AND ANNALS OF

ASTRONOMY, BIOLOGY, GEOLOGY, INDUSTRIAL ARTS, MANUFACTURES, AND TECHNOLOGY.

(MONTHLY, FORMERLY "THE QUARTERLY JOURNAL OF SCIENCE.")

POST TENEBRAS LUX

Vol. VI. (THIRD SERIES)
No. CXXIV.

APRIL
1884.

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LONDON:
3, HORSE-SHOE COURT, LUDGATE HILL.

Where Communications for the Editor and Books for Review may be addressed.

PRICE ONE SHILLING AND SIXPENCE

THE

JOURNAL OF SCIENCE.

APRIL, 1884.

I. HYBRIDISM WITH REFERENCE TO THE THEORY OF EVOLUTION.

By J. W. Slater.

THE rarity, or rather, in the opinion of some persons, the absolute non-existence of true hybrids capable of reproduction, is sometimes yet brought forward as a fact hostile to the doctrine of Development. Even avowed Evolutionists occasionally make such statements as the following, which we have recently met with in a book of much merit:—"The objection drawn from the physiological difference between species and races still exists unrefuted," and is indeed "the great stumbling-block to all theories of Evolution."

It will therefore not be an idle undertaking to re-examine the facts bearing on this question, and see whether they necessitate or admit of the interpretation so often put upon them.

Briefly recapitulating the views of the Old School we find it asserting that whilst orders, families, and genera are mere man-made groups, having no actual existence, species possess, on the contrary, a distinct objective character. Each such species consists of animals—or plants—which are, or might have been, descended from one original couple, and it is distinguished from every other species *morphologically* and *physiologically*. The morphological characteristic was a structural resemblance between the individuals of one and the same species, coupled with a structural dissimilarity

from individuals of any other species. This combined likeness and unlikeness was, however, and is still, very difficult to estimate, whence in many cases there arose great difference of opinion as to the number of species of some particular group inhabiting any given country. This very fact, by the way, contributed no little to undermine, in the minds of careful inquirers, the notion of the absolute distinctness of species. To supplement the morphological boundary between species and species the so-called "physiological test" was appealed to. If two individuals of opposite sexes were seen *in copula*, this observation was taken for proof positive that they belonged to the same species. In like manner it was held that a brood of young animals must belong to the same species as their mother, or as both their parents if discoverable.

It must be admitted, however, that for multitudes, especially of the smaller animals, this so-called "physiological test" has not the slightest value. In how many, or rather how few, cases can we trace the entire series from the copulation of the parent animals to the appearance of the young!

Another point in the creed of the Old School was the broad, absolute distinction between "species," "variety," and "race." Species was a something primordial and absolute; race, a something formed by change of climate, diet, or other surroundings. Races might pass into each other; species, however structurally similar, never. Fruitful intercourse was possible between individuals of different races, but not between those of different species.

I shall not, I think, be open to the charge of misrepresenting the views of the Cuvierians on the question of hybridism if I put forward the following propositions, which are all, explicitly or implicitly, contained in their writings, and which are, indeed, the logical outcome of the doctrine of the Immutability of Species;—

I. Without human interference sexual intercourse never takes place between individuals of different species.

II. If by dint of such interference connection does happen, it is normally unfruitful.

III. In the exceptional cases where a hybrid is produced it is barren or impotent, and incapable of reproduction.

All these propositions can, I think, be successfully controverted.

As regards the first assertion it is, of course, refuted by all the very numerous instances where hybrids have been produced without any human aid or contrivance. But there are, further, cases almost innumerable of intercourse between animals of widely different species where no offspring has been known to result. Thus there is on record ("American Naturalist," xvii., 359) the long-continued intimacy of a male elk with a Durham heifer. A stag has been known to pair with cows in Scotland. The present writer once saw, in Austrian Silesia, a hound copulating with an ewe, and was told that this was a very common action on the part of the dog. A Newfoundland dog has been known to have intercourse with a sow. Without needlessly multiplying further examples I may lay down, as a counter-proposition based upon facts, that—

> "Male animals, without human interference, will, in default of a mate of their own species, pair with any female not too dissimilar from themselves in size, structure, and habits."

Let us turn to the second proposition. The number of hybrid forms which have been produced is so great that their birth cannot be regarded as an abnormal result. Macgillivray, as quoted by Darwin in the "Descent of Man," gives an instance of a male blackbird which paired with a female thrush, and produced a family of young birds. The great wood-grouse (*Tetrao urogallus*) very commonly espouses the black hen (*T. tetrix*), and the hybrids sprung from this alliance have been recognised as a distinct species under the name of *Tetrao medius*, and in some districts are, according to Semper, superseding the pure strain of black game; whence it may be fairly concluded that *T. medius* is not incapable of reproduction. In the gardens of the Paris "Society of Acclimatisation" there are, or were in 1882, two male hybrids, one between a Houdan cock and a Guinea hen, and the other between a Cochin China cock and a turkey hen. According to Darwin (*opus citat.*, p. 414) eighteen cases have been recorded, in Great Britain alone, of hybrids between the black grouse and the pheasant. A wild duck has been known to nest with a male pintail, and rear a brood of seven or eight hybrid ducklings. According to Rev. W. D. Fox (*ibidem*) "a pair of Chinese geese (*Anser cygnoides*) were placed on the same pond with a common gander and three geese. The result was that of the young birds hatched from the eggs of the common geese only four were pure, the other eighteen proving hybrids."

The Rev. E. S. Dixon, quoted in the same work, remarks that "those who have kept many different species of geese together well know what unaccountable attachments they are frequently forming, and that they are quite as likely to pair and rear young with individuals of a species apparently the most alien to themselves, as with their own stock."

Waterton ("Essays," p. 400) mentions that a female Canada goose paired with a bernacle gander, and that they produced a brood. The hybrids which have been produced between different species of song-birds are, as every bird-fancier can testify, exceedingly numerous.

In short, the second proposition of the Old School has literally not a leg to stand upon, if it claims to rank as a general truth. It can be merely tolerated in the following very modest form:—"If animals of different species copulate, some will produce viable young, and others not."

We come now to the last of the three propositions, which asserts that if the intercourse of a male and a female of different species produce young, the latter are barren.

In refutation we will take first the case of the American bison and the domestic cow. According to Mr. J. A. Allen's valuable monograph ("History of the American Bison") it is distinctly shown that the bison bull interbreeds freely with the domestic cow, and that the half-breeds are fertile. This fact is of the greater importance since the two animals belong to distinct genera.

We must not forget the case of the so-called "*leporides*," hybrids between the hare and the rabbit, the existence and the reproduction of which have been admitted in "Cosmos les Mondes," a paper assuredly free from any Evolutionist leanings. There is also no well-founded doubt that the blood of several distinct species of Canidæ has been mingled to form the domestic dog. The Japanese lap-dog (*Drysodus pravus*), though differing generically from the common dog, interbreeds with it freely.

We come now to birds. That the hybrid between *Tetrao urogallus* and *T. tetrix*, above mentioned, is capable of reproduction seems to be a necessary inference from its multiplication. But as I am not aware that any observer has actually seen a nest where one of these hybrids was either father or mother, I will not insist on this case. A far more important instance is that recorded by Mr. Seebohm in his "Siberia in Asia," and it is the more completely satisfactory because every possibility of human interference is absent. The carrion crow and the hoodie mate freely together. According to Mr. Seebohm, in the district of Yeniseisk

75 per cent of the crows are thorough-bred carrions, perhaps 5 per cent pure hoodies, and the remaining 20 per cent are hybrids of every stage between the two. He found pairs of such hybrid birds mated together, and producing eggs and young. This instance is the more valuable because it meets the cavil that though a hybrid may fecundate, or be fecundated by, an animal of the original pure strain, yet two hybrids cannot prove prolific together.

It is on account of this cavil that I lay little weight upon the instance of the she-mule now in the gardens of the Society of Acclimatisation, of Paris. This animal has brought forth six foals, by zebras, by an ass, and by a stallion.

The third proposition is therefore fully refuted. If there were between distinct species some absolute, primordial, Divinely-ordained boundary to prevent the intermixture of species, we might surely expect that in every case copulation between animals of such different species would be absolutely null and void. In other words, in such a case the male element would produce no more effect upon the germ-cell than would the contact of a drop of water, or of blood, or of milk. But in place of this absolute action or nullity we find a series of effects ranging from nullity upwards. In some cases there is doubtless no action at all. In others the germ-cell exhibits segmentation more or less normal, which, however, becomes prematurely arrested. In a third set of cases there is a production of living young, and in a fourth these young are themselves capable of reproduction. These facts are totally irreconcilable with the theory of an absolute boundary. In part they are already explained by very simple mechanical considerations (*see* Dr. Pflüger's researches on the Hybridisation of Amphibians, "Journal of Science," 1884, p. 30). Thus in some cases the spermatozoids, from their size and shape, are prevented from entering the ovum owing to the narrowness of the micropyle. All this, I repeat, is quite out of harmony with the teachings of the Old School.

There is another consideration not to be overlooked: when a negative dogma is to be met by positive instances, and we find a notable amount of such instances after surveying only a very small portion of the field, we may not unfairly argue that on further inquiry these instances will be multiplied. On the other hand, they cannot be diminished. Hence we have everything to hope and nothing to fear from further research. We see, *e.g.*, among birds, how many instances of the production of hybrids have occurred among those

three groups which have come most extensively and closely under human observation,—to wit, the poultry tribe, the geese and ducks, and the finches and thrushes. It is surely therefore reasonable to expect that if other families of birds were submitted to similar investigation, the number of affirmative instances would be increased. I may safely say that not one species in a thousand has been examined so closely that we can say with anything like confidence whether it is capable of reproduction with some allied species or not. If we observe animals in a state of nature we may, perhaps, not find a crucial instance once in a quarter of a century. If we experiment upon them in captivity we are met by the difficulty that many animals do not breed freely in confinement, even when mated with one of their own species. Differences of temperature, of diet, of exercise, of exposure to light, and a variety of other circumstances not capable of affecting the health of an adult animal, may yet prevent it from breeding, or may prove destructive to its young. For anything we can show to the contrary many existing species may have had their origin in hybridisation.

Let us now discuss some of the arguments used to explain away, if possible, the facts which have been brought forward. We hear it sometimes said that if two animals are capable of engendering together they must belong to the same species. If this assertion is valid, then the horse, ass, and zebra are merely different races of one and the same species. So, too, are respectively the American bison and the common cow; the dog, wolf, and fox; the lion and the tiger; the hare and the rabbit; the hoodie and the carrion crow; the blackbird and the thrush; and multitudes of other species differing from each other in form and in habits. In short, to preserve a dogma, for it is nothing more, the classification of the animal—and in like manner of the vegetable—world is to be thrown in heaps. This plea is, in short, an excellent instance of the working of the principle *tant pis pour les faits!* But we may take another step. Suppose that the copulation of two animal forms, ordinarily held to be distinct, leads, not indeed to the birth of living young, but to the earliest stage of conception, or, in technical language, to the segmentation of the ovum, what are we then to conclude? Do the two animals belong to one and the same species? If they do, they ought to be capable of producing viable young. If they do not, then, according to the creed of the past, their intercourse should be utterly null and void.

Again, we may take the case of the mule, ordinarily infertile. If its parents belong to one and the same species they ought to reproduce not merely a living, but a fertile offspring, If our opponents seek to get over this difficulty by pleading that the horse and the ass, though of the same species, belong to different races, they make the admission —ruinous to them—that there is no absolute difference between race or variety and species, the former being at least a stepping-stone to the latter. "Ruinous," I would say, because it in effect involves the abandonment of their vaunted physiological characteristic of species as distinct from varieties.

The second plea of the Cuvierians—if they will permit me to call them so—is not more valid than the first. Looking over the long list of cases above given, they say—"But these are mere exceptions, and there is no rule without exceptions!" I am half inclined to suspect that this very notion of exceptions to all rules is a proof of the radically unscientific character of the minds which entertain it. I find in an important paper in the "Deutsche Rundschau," by Professor Preyer, of Jena, the following very significant remarks:—"The philologian only will refuse to admit that grammar, *with its endless exceptions*, is a heavy load for the memory rather than a discipline for the logical faculty. The student thus, almost involuntarily and unconsciously, learns to *admit exceptions in the case of other rules, such as the laws of Nature.*" Now in the rules or laws of Nature, when founded on a proper induction and clearly understood, there are no exceptions. If you can give us one instance of the destruction or the creation of matter, the so-called law of the permanence of matter falls at once to the ground, or is seen to be no law. If by any manipulation of ours we can, in any one case, create energy, the law of the conservation of energy must be forthwith given up. If one only of the elementary bodies of chemistry is found capable of combining with other bodies in fluctuating proportions, the atomic theory goes to the winds; and, just in the same manner, if we have one single instance of fruitful intercourse between animals of different species, the assumed law that such an event is impossible, and with it the physiological test of species, is annihilated, or rather is found never to have had a rightful existence.

But the notion of "no rule without exceptions," idle as we have seen it to be, is capable of assuming a more malignant phase. We sometimes hear it said that "the exception proves the rule." This floscule is most common

in the mouths of historians, grammarians, and the like. Sorely perplexed would these worthies be if called upon to show, in the case of any law of Nature such as those we have mentioned above, how an exception could "prove the rule." Indeed the persons who apply this phrase to natural questions prove two things,—their inborn or inbred inaptitude for Science, and their ignorance of their own craft. For the origin of the saying may be illustrated by the following examples:—If we find that in some country or at some age an especial legislative act or royal charter was necessary, *e.g.*, to enable some man to obtain a divorce, we may then conclude that in the rule, in the common course of law, divorces were not granted; and here therefore, and in a host of parallel matters, it is rational to say "the exception proves the rule." But it will be at once seen that there is here no possible remotest analogy with anything in the laws or rules which we discover in Nature.

Looking over the facts brought forward and the considerations advanced I certainly fail to see how the absolute infecundity of animals of different species and the so-called "physiological test" can justify themselves to any candid inquirer.

II. DAILY VARIATIONS OF THE STRENGTH OF THE WIND ON LAND AND AT SEA.

THE researches of Herr W. Köppen on this subject have been recently laid before the public in the "Naturforscher."

Though the daily periods of temperature and of barometric pressure, as well as a number of other meteorological elements, have been for many years the subject of close examination, it is only of late that the daily period of the strength of the wind has been taken into consideration. Yet this very feature shows itself more distinctly and generally than any other meteorological element, with the sole exception of the temperature, and perhaps of relative moisture. As will appear below, the daily period of the strength of the wind is perhaps even of greater significance

than that of the variables just named. The most striking characteristic of this periodicity is the intensification of the wind in the hottest time of the day,—a feature which, according to Hann, is recognised in all continental stations, whatever may be their climate or the prevailing character of their winds.

This daily maximum of the strength occurs in Upsala, Cracow, Hamburg, and Dresden, at 1 p.m.; at Vienna, Birmingham, Liverpool, Toronto, Calcutta, and Ascension, at 1.30 p.m.; at Prague, Oxford, Batavia, and Melbourne, 2 p.m.; Petersburg, Halifax, Mauritius, 2.30; Bern, 3; and Rome, 3.30 p.m. At these places the entire daily variation in the strength of the wind takes place while the sun is above the horizon. During the night the wind is equally low, and even in the first hours after sunrise it varies little from the nocturnal value. The wind arises, especially on clear days, some hours after daybreak, and subsides again at night. In the intermediate time it increases towards noon; and in plains, in the interior of tropical and subtropical continents, it reaches daily almost the intensity of a storm. This is especially the case in the region of the trade-winds and in the dry season.

In the open sea, as has been recently shown by Mr. Buchan from the observations made on board the *Challenger*, the case is quite different. In the middle of the ocean there is scarcely any appreciable daily variation in the strength of the wind. It retains during the night the same relatively high figure which appears by day. According to two concordant observations, however, the trade-wind shows a slight periodicity, the maximum being at 8 a.m. and the minimum at 4 p.m.

The increase of the speed of the wind in the warmer hours of the day, observed as a universal fact on land, is confined, however, to strata of air which are for considerable distances in direct contact with the earth's surface. In the free, upper regions of the air, the wind is not stronger at noon than at morning and evening, but weaker. This fact was first demonstrated by Hellmann on Mount Washington and on the Righi. Köppen gives several other instances of a similar nature.

As far back as 1840 Espy gave a satisfactory explanation for the main features of the daily periodicity of the wind :—
"The beginning of the formation of ascending columns of air in the morning will be accompanied by an increase in the strength of the wind, and its strength will grow with the increase of these columns, both phenomena keeping step

with the rising temperature. This acceleration of the wind is in part determined by the influx of air on the earth's surface from all sides towards the centre of the rising columns, which thus produces inconstant breezes; in part also by the descent of air in the regions surrounding the ascending columns. Such descending air retains the velocity which it possessed in the upper regions, and which is well known to be greater than that of air in immediate contact with the earth's surface."

Without any knowledge of Espy's explanation, Köppen, as far back as 1879, whilst discussing Hann's observations, propounded the hypothesis that the daily periodicity of the wind depends on two conditions—1st, the varying intensity of the perpendicular exchange of air in the lowest 1000 to 4000 metres of the atmosphere, with a motion which on the average increases from below upwards, on account of diminishing friction; 2nd, the preference of the warmer hours of the day, in consequence of the appearance of steep gradients by difference of pressure at small distances. This explanation is practically at one with that of Espy,—a fact so much the more interesting as the latter *savant* had at his command in 1840 but a scanty array of facts for his inferences, whilst now a formidable series of arguments can be produced in favour of this hypothesis.

The latter of the two causes mentioned consists in the especial occurrence of thunderstorms, with their accompanying depressions, local whirlwinds, &c. The nature and the local movement of the gradients may be seen strikingly illustrated in Köppen's memoir on the thunderstorm of August 9th, 1881. As these gradients may have very different directions, and may be propagated very differently, all the winds may undergo in the course of time such temporary accelerations which, by their occurrence in the hottest part of the day, contribute essentially to the known form of the wind on land.

But this cause accounts for merely a subordinate portion of the phenomena of the daily period of the strength of the wind. This is shown by the fact that the mid-daily acceleration of the wind is often very distinctly characterised in cases where the foregoing explanation is manifestly inadmissible. This is especially the case in great aërial currents which retain an approximately constant direction. As examples we may take the trade-wind in the dry season in the interior of Africa and South America, and the persistent east winds accompanied by dry clear weather in the temperate zone.

The efficacy of the other cause, which we must consequently acknowledge as the main cause of the entire phenomenon, is easily seen. The velocity of the movement of the air augments, generally speaking, from the earth's surface to a great altitude, on account of the decrease of friction. When, therefore, masses of air arrive from the heights at the surface of the earth they bring with them, generally speaking, a greater horizontal velocity than the masses of air under the same gradient which have been in prolonged contact with the earth's surface.

Since cold air, at the same external pressure, is denser—or, in other words, heavier—than warm air, there follows, when the magnitude of the decrease of temperature exceeds a certain value, an unstable equilibrium. A mass of air which has begun to sink becomes denser than its surroundings, and thus is impelled to sink lower, and, inversely, a mass of air which rises is inclined to further ascent. The vertical decrease of temperature which corresponds to this unstable equilibrium is 1° C. per 100 metres for dry air, and between ½° and 1° C. for moist air. If this value is reached everywhere, or partially over a large surface, there occurs a play of descending and ascending currents of air which in damp weather makes itself manifest by cumuli piled up like mountains with blue interstices. The clouds represent masses of air which are ascending, in consequence of the decrease of pressure on being refrigerated. Hence a part of their moisture is separated out in the shape of the minutest drops, forming clouds. The clear, cloudless intervals are formed by descending masses of air which are experiencing the opposite process, of increasing temperature and heat, and are consequently removing further from their point of saturation.

The mean value of the decrease of temperature upwards is greatest in the warmest hours of the day. In the night the difference of temperature between above and below becomes insignificant. In clear nights there is even, up to a certain altitude, a regular inversion of the difference, the temperature at the earth's surface being lower than it is above. This involves a very stable equilibrium of the air and a very trifling vertical circulation. In calm days, with bright sunshine, therefore especially in summer, the previously mentioned unstable equilibrium sets in a few hours after sunrise, and ceases a short time before sunset. The daily period of the velocity of the wind has the greatest correspondence with the formation of cumuli; but the connection of the two phenomena is far from complete, since

the formation of cumuli demands a certain degree of atmospheric moisture, and depends also on perpendicular currents which do not necessarily extend down to the lowest stratum of the air.

The correctness of these views is demonstrated by the fact that a series of conclusions which necessarily follow are unmistakably confirmed by observation. These are accordingly here enumerated :—

1. Wherever the daily variation of temperature and the retardation by friction are both very trifling, the mid-daily intensification of the wind—or, more strictly, the nightly lull of the wind—is wanting, even at the surface of the earth. This occurs on the open sea. The very slight friction at the surface of the water determines a very slight increase of the wind on ascending. Again, the perpendicular currents are substantially not connected with a daily period, as the daily fluctuation of temperature, even in the lowest stratum, does not exceed 0·7° C.

2. Where the intensified perpendicular circulation of the air in the warmest part of the day brings air from tranquil strata, there occurs an inversion of the period. The warmest hours of the day are then marked not by an increase, but by a decrease in the strength of the wind. This is the case on the summits of mountains which rise to a certain height over a varied landscape with a well-marked daily fluctuation of temperature, but which do not themselves greatly influence the surrounding atmosphere.

3. The daily period of the wind displays characteristic relations to other phenomena, especially to vapour-tension. In all districts where the circumstances are favourable to a periodical powerful development of the perpendicular circulation at the hottest time of the day, and where accordingly the mid-daily intensification of the wind is distinct, the vapour-tension, as far as is known, has its minimum in the warm hours and its twofold maximum in the morning and evening. This decrease at the time of greatest heat can be explained only by the fact that air, poorer in moisture because warmer, arrives from the upper regions to the surface of the earth. This phenomenon occurs only at the bottom of the atmosphere in valleys or on plains. On the mountain tops the vapour-tension, like the period of the wind, is inverted, the maximum occurring when the warm moist masses of air rise up from the low-lands.

4. On those sea-coasts in the region of the trades which have no regular sea-breeze, the trade-wind blowing over the land blows more strongly by day than by night, and shows

the same daily period of velocity as is found in the interior of the continents. Of this a signal proof is given by the indications of the anemometer at St. Helena and Ascension.

5. The diminution and inversion of the daily periodicity of the wind on high mountains does not depend on the absolute height of above the sea-level, but on the free exposure of the station on a summit of sufficient height above a varied region. Thus Köppen made observations on the Puy de Dome and on the Pic du Midi. On the former he observed a decrease and on the latter an increase of the wind at noon. The explanation of this apparent anomaly is that the station of the Puy de Dome is situate on an open rounded summit; that on the Pic du Midi lies 500 metres below the summit.

6. Researches on the relation of the velocity of the wind to the gradient, which have been undertaken by Mr. C Ley for England, and by Herr Sprung for the German coasts, give the accordant result that at 8 a.m. one and the same gradient is accompanied by a stronger wind in summer than in winter; stronger, also, with a north-easterly than with a south-westerly wind. But according to the researches of Hann and others the decrease of temperature upwards is on the average greatest in summer, and in time of north-easterly winds. As the magnitude of this decrease is generally parallel to the strength of the perpendicular exchange of air, it follows that for equal gradients there ensues a stronger wind when this exchange of air is brisk than when it is feeble, as the theory demands.

7. A particular importance attaches to the observation made independently by HH. Hjelström and Sprung, that cloudiness has a well-marked influence on the daily period of the wind. During east winds with a bright sky the daily variation is more distinct than during westerly winds accompanied by cloudy weather. A clear sky which permits free radiation acts in two directions: by day it increases the vertical exchange of air by augmenting the vertical decrease of temperature, and consequently it intensifies the velocity of the wind in the lower strata of the air. At night, by refrigerating those strata it produces a firm equilibrium in the vertical direction, and thus withdraws the lower air from the influence of the upper, more rapidly moving, atmospheric strata. If the gradients are the same, there is therefore a stronger wind by day and a weaker by night in clear weather than under a cloudy sky.

8. Perhaps the most interesting feature of the daily periodicity of the wind is its relation to the daily variation in

its direction. In a special memoir on this subject Herr Sprung has shown that an intensification of the wind whilst the gradients remain unchanged is, under ordinary circumstances, conceivable only if the angle of deviation is simultaneously augmented. In fact the observations made at eighteen stations in the interior of the Eastern Continent show, in the forenoon, on the average, a decided deviation of the wind in accordance with Dove's law of deflection, whilst in the afternoon deviations in the opposite direction slightly predominate. The predominance of deviations of the wind along with the course of the sun—which is determined by the position of the north temperate zone with reference to the predominating tracks of barometric minima —is increased in the forenoon, but decreased in the afternoon, by a cause acting periodically. This cause is the descent, into the lowest stratum of the atmosphere, of masses of the upper air which are moving more rapidly and at a greater angle to the gradient. On account of the increased angle of deflection the track of the clouds deviates, as is well known, to the right hand of the wind. Observations on cloud-movements reveal, in the upper strata of the atmosphere, a daily period in the direction of the wind opposite to that which obtains below, quite analogous to the inversion in the period of its velocity.

III. HALF-HOURS WITH THE OLD NATURALISTS.

[Under this title we propose giving, from time to time, sketches of the lives and researches of the earlier investigators of living Nature.]

I. JOHN SWAMMERDAM.

LET us cross not merely the German Ocean, but the last two centuries, and visit Holland in the olden time: Holland which for her size and population produced more *savants* of mark than any other country of modern Europe; Holland which amidst her eager and bustling commercialism found time and appreciation for the

profoundest studies; which did not think intellectual bondage a price necessary to be paid for political freedom; which gave to thinkers in exile an asylum and a free press; and which, in short, did such noble things that we may almost pardon her for her two deadly sins—the invention of national debts, and of chicory. Such was Holland in the seventeenth century.

The time and the place, too, were well fitted to call general attention to biological studies. The vast commerce of the Netherlands and their extended colonial empire rendered the importation of "natural curiosities" an easy and a common matter. The shells, the insects, the birds of Guiana, the Cape, and Java, were as startling and as much sought after as are now those of New Guinea or Central Africa. Hence we need not wonder if the formation of private museums became a favourite amusement among the wealthier burghers of Amsterdam. Many of these collections were doubtless mere dilettante affairs,—raree-shows, where curiosities were stored up heedless of their nature and their origin, and were admired for their beauty, their rarity, and their cost, rather than studied. But in many cases these accumulations of specimens converted both owners and visitors into naturalists of various degrees of merit.

Among these museums probably the finest and the most celebrated was that belonging to John James Swammerdam, a prosperous apothecary, or, in modern English phraseology, chemist and druggist. This worthy burgher took to wife Barentje Corver, and in time became the father of John Swammerdam, the subject of our memoir. The boy was from the earliest dawn of his understanding surrounded by zoological specimens, and from the joint influence, doubtless, of hereditary taste and early association, he became passionately devoted to the study of Natural History. When a mere boy he began to collect insects, Mollusca, &c.; but he did not—as it was the fashion before his time, and as it is still common—merely collect. We find him studying the habits and the development of these creatures, and, with such appliances as he could procure or devise, examining their inward structure. Hence we need not wonder that when his future career in life became a question for family discussion he—like in after times Darwin—felt no taste for the study of Divinity, as his father had intended.

Medicine was next suggested as being more in harmony with his tastes and studies. But it was not until he had reached his twenty-sixth year that he entered the University

of Leyden, which then enjoyed a high and well-merited reputation as one of the first medical schools of Europe. How young Swammerdam had been engaged in the meantime, save with the study of Entomology, is not recorded. Very probably the delay was in great part owing to the "delicate" health—to use an absurd modern perversion of language—which he never could shake off. At Leyden he enjoyed the instructions of Van Horne in Surgery, and of the then famous Sylvius de la Boe in Medicine. Here Swammerdam soon distinguished himself for his skill in anatomy, and especially in the preparation of anatomical specimens, in which art he opened up a new era. Here, too, he made the acquaintance of several important men, among others Steno, who was for many years his firm friend and admirer. Here, also, began his enmities and controversies, especially one with Rynier de Graaf, who claimed the merit of Swammerdam's methods of making preparations, though, as far as it can be traced, without a particle of justice. We need not be surprised if the wronged discoverer replied with some acrimony. Indeed Swammerdam's temper, like that of dyspeptics in general, was not of the sweetest; but in his many controversies we find a due discrimination between men of merit, who may have fallen into an error, and charlatans, who lay claim to the researches of others and adulterate them with their own absurdities. Witness his critique on Harvey's celebrated treatise "De Generatione," and his denunciation of Gœdart, whom he accuses of defiling the views of Harvey.

About 1665 we find him visiting several parts of France for the benefit of his health. He lived for some time at Saumur, and it is said at Lyon. Here he had the advantage of studying a fauna differing in many respects from that of Holland, and here he continued his entomological researches. In particular he studied various species of dragonflies and the Ephemeridæ. Here he began that treatise on *Ephemera Swammerdamiana*, as now named, which Prof. Westwood justly pronounces admirable. Whilst at Saumur he seems also to have discovered the valves of the lymphatics.

Thence he repaired to Paris, and in company with his friend Steno, resided for some time at the house of Thevenot, at Issy, chiefly engaged with dissecting insects. Here he was introduced to the Senator Van Bemmingen, at that time Dutch Ambassador at the French Court.

Returning to Holland he was chiefly engaged with the study of Human Anatomy and of Medicine, and became the leading spirit of a medical society founded at Amsterdam.

In 1667 he graduated at Leyden as Doctor of Medicine, after maintaining an inaugural thesis on respiration.

In the same year, however, he was attacked by a violent quartan ague, which left him permanently enfeebled. Partly in consequence of this calamity he abandoned his researches in Human Anatomy, and gave himself entirely up to Entomology.

In the following year the reigning Grand Duke of Tuscany, an enlightened prince, paid a visit to Holland. Here he went to visit the Swammerdam museum, and made the acquaintance of our hero. The Duke was so favourably impressed with what he saw and heard that he offered to purchase the collection of the younger Swammerdam—as distinct from the museum of the father—for a large sum, and to give him a permanent appointment at his Court if he would remove to Florence. Unfortunately for himself and for Science Swammerdam declined this offer, having, as he then thought, too great a love for independence. I say "unfortunately for Science," because had he accepted the Grand Duke's proposals his museum, instead of being broken up at his death and lost, would have been kept together. He would also have had full opportunity to devote the remainder of his life to researches on a different fauna.

I must now mention an incident of some importance in the history of Science. Either during this visit of the Grand Duke to Holland, in 1668, or during an alleged visit of Swammerdam to Florence, in 1678, he showed that Sovereign and his Court that when a portion of a muscle of a frog's leg, hanging by a thread of nerve bound with a silver wire, was held over a copper support so that both nerve and wire touched the copper, the muscle immediately contracted. This is nothing less than an anticipation by a century of the famous initial experiment of Galvani!

Swammerdam's experiment, however, led to nothing. The phenomenon produced was too remote from the ordinary sphere of his studies, his time and energies were fully preoccupied, and there was no Volta to interpret the fact. Otherwise we might have been in these days speaking of Swammerdamic batteries, Swammerdamometers, and the Swammerdamic current—cumbrous words, it must be confessed.

About this time Swammerdam denied the reputed acidity of the pancreatic secretion, and was engaged in consequence in a fresh controversy with Rynier de Graaf, and with his old master Sylvius de la Boe, whom he finally refuted in 1672.

In 1669 he wrote the larger part of his great history of insects, which, however, he did not at once publish. He had got together upwards of 3000 species of insects,—a large collection for the seventeenth century,—and had examined them with a care and an accuracy which hitherto had had no parallel. He had dissected most of the species, traced their development from the larva—or whenever possible from the egg—to the mature form, and had refuted the fabulous notion, handed down from the days of classical antiquity, that they are or may be generated from putrescent matter. He laid the foundations of the anatomy of insects. He devised a kind of dissecting microscope, and introduced the use of scissors for delicate operations, as being less liable to tear the tissues than knives. He injected coloured fluids, in order to render the different parts more distinct and to show their connection. For this purpose he employed minute glass tubes. He had not, of course, at his command the high magnifying powers of the modern microscopist, nor the polarising apparatus, but the general accuracy of his descriptions and his drawings has often excited the surprise and admiration of modern observers.

In the course of the year 1669 he encountered a new and very serious trouble, which continued almost to the end of his life. The elder Swammerdam would rather have seen his son a routine practitioner, writing out prescriptions and pocketing fees, than a brilliant discoverer. Hence a quarrel resulted. The old apothecary threatened to stop his son's allowance if he did not immediately give up his researches and devote himself to practice. By way of appeasing his father he undertook to clean, re-arrange, and catalogue the family museum,—a laborious task, for which a man of much inferior abilities would have been amply sufficient, and which to him was both waste of time and weariness. He was, however, physically unequal to the fatigues of medical practice.

In 1670 he had another attack of illness, and was forced to retire into the country for change of air and rest. His rest, however, consisted in completing his treatise on the Ephemera, which was not published until the year 1675. The following year he sent his plates of the anatomy of the human uterus, which had been drawn in 1667, to the Royal Society, accompanied by a series of injected preparations and a full account of his methods.

So far we have seen him bravely struggling on amidst all the difficulties of failing health, scanty means, and family discord, yet sustained by the pure love of truth. But a sad

change was impending. There had sprung up about this time a female fanatic, Antonia or Antoinette Bourignon. Had this woman lived in our "advanced" days she might have become an ethicist, a Bestiarian, and have written "Perfect Ways" or "Peaks of Darien." In the seventeenth century, however, such resources for abnormal women did not exist, and the Bourignon accordingly became a sect-founder and heresiarch. What were her especial tenets the readers of the "Journal of Science" will scarcely trouble themselves to inquire. Suffice it to say that her sect was anathematised by the Kirk of Scotland, and that she, like not a few kindred spirits, whilst eager for power and influence, was in no way blind to her private interests.

Some of her books fell, in an evil hour, into the hands of Swammerdam, who unfortunately read them and felt interested in them—a circumstance perhaps due to his morbid condition. He felt a desire to know more of her teachings. A friend did him the ill-service to effect an introduction. Bourignon, who was then living in Holstein, flattered, perhaps, at the prospect of enlisting among her followers a man of high reputation, allowed him to write to her, and vouchsafed to answer his letters. She soon acquired a strange and unexplained ascendancy over him. He did not presume to publish anything without her formal permission. She taught him to regard scientific research as a "worldly" and sinful waste of time which might better be devoted to mystical reverie. It is singular how in this respect her teachings practically coincided with those of some of our modern ethicists, who, though certainly not overburdened with religious beliefs, tell us that research makes us neither better nor happier, and is therefore a waste of time! The one and the other of these misleaders ignore the fact that with certain minds the search after truth is a ruling principle, quite independent of any benefits, outward or inward, which may arise. With us the craving for knowledge is just as much its own justification as is the craving for goodness.

We must again pronounce it strange that a man so independent, so fond of his own way as was Swammerdam, should allow himself to be dictated to by an ignorant fanatic. He who had rejected, it is said, with scant courtesy, the liberal offers of the Grand Duke of Tuscany, does not rise in our estimation when he becomes the vassal of a Bourignon.

Meantime he still engaged in researches on hernia, proving that it does not involve a rupture of the peritoneum. He

exhibited the spore-capsules of the so-called male fern to Arnold Syen, then Professor of Botany at Leyden. His illustrations of the spores themselves and of the sporangia are the same as those given by more recent authorities.

His last great task, however, was the completion of his treatise on Bees,—a work involving immense labour. Daily from 6 a.m. till noon he was engaged in dissecting and drawing. And this work he could no longer perform, as formerly, with unmixed satisfaction. Bourignon continually upbraided him, in her letters, for his devotion to "worldly" pursuits. In the language of Bœrhaave he laboured "amidst torments and agonies of mind and self-reproaches." When his task was completed he threw the manuscript and drawings on one side, and seemed utterly careless as to their destination. Either this treatise or his letter to Bocconi on the growth of coral must be regarded as his last work. In this epistle he regards coral as a cryptogamous plant analogous to the ferns,—an error which he would assuredly not have embraced if he had enjoyed the opportunity of studying them whilst growing.

We thus come to the end of his researches. It is said that he burnt a considerable proportion of his manuscripts in obedience to Bourignon, and that others would have shared the same fate had they not previously been sold to Thevenot. Any attempt to introduce scientific conversation now, so far from giving him pleasure, led merely to an outburst of anger, which might have been ludicrous had he been less to be pitied.

Swammerdam's only wish seemed now to retire from the "world," and devote the residue of his life to meditation. The family troubles did not subside. The elder Swammerdam broke up his house, and went to live with his daughter and son-in-law, leaving our poor misguided naturalist homeless. In this extremity he attempted to sell his museum, but found no purchasers. In fact his natural perverseness of disposition and his devotion to Bourignon had repelled many of his former well-wishers. His old friend Steno had accepted an official position at Florence, had joined the Catholic Church, and had been raised to the dignity of Bishop, *in partibus*, of Titiopolis. The news of Swammerdam's distressed condition having been carried to Italy, this prelate, at the instigation of the Grand Duke, reopened the negociations of 1668, offering his former friend and colleague the sum of 3000 crowns for his museum, and promising him an asylum at the Florentine Court. At the same time it was hinted that his adhesion to Catholicism, if not an

imperative condition, would be favourably construed. Swammerdam was furious, and upbraided his old friend as an apostate.

At last the death of his father, in 1677, put an end to his financial difficulties, though his sister and her husband secured the lion's share of the inheritance. The family museum, when disposed of, fetched but a small fraction of its estimated value.

The relief, however, came too late. Swammerdam's health was hopelessly ruined by repeated attacks of ague and by the debility consequent upon overwork, and often insufficient diet acting upon a constitution feeble from the beginning. But even if his health had been preserved he would have been, thanks to the influence of Bourignon, lost to Science. He died in 1680, or, acccording to some authorities, in 1682.

In endeavouring to judge of his position in the history of biological Science, we must not overlook the shortness of his career. Dying at the early age of 43, or at the longest estimate of 45, much of his time being wasted by sickness and the last six or seven years rendered a blank at the dictates of fanaticism, we can only wonder how he contrived to crowd so many important discoveries into so narrow a span.

He had in the highest degree all the attributes which mark the eminent observer. In delicate and subtile manipulation, in contriving new methods to meet every case, in acute and accurate perception, he has never been surpassed and rarely equalled. Above all he must be remembered for his untiring industry and perseverance.

As a generaliser he was much less distinguished. His entomological classification, based essentially upon their development, and especially upon the peculiarities of their pupa state, had merely the value of bringing the so-called transformations of insects into notice, and is now without any save a historical interest. His lack of a definite nomenclature is a great drawback. Were it not for the figures in his "Bibliæ Naturæ" many of the species described could not be identified.

His works contain a large admixture of teleological passages, and generally speaking of moral reflections, much more dyspeptic than philosophic, and remarkable neither for depth of thought nor grace of expression. These meditations remind the reader irresistibly of the morals formerly "tagged" on at the conclusion of a dramatic work.

Had he but possessed a vigorous constitution he would

have been greater both as a *savant* and as a man. Nevertheless, whilst we regret his weakness, we must hold him in high honour for the good and abundant work which he performed. It is sad to see in some biographical works he occupies a less space than is allotted to Bourignon. Figuratively speaking the *Phylloxera* is honoured more than the vine!

IV. THE DUKE OF ARGYLL'S REIGN OF LAW AND UNITY OF NATURE.

By James Simson.

IN my "Contributions to Natural History, &c.," published at Edinburgh and in London in 1875, and with an Appendix in 1880, there is an article entitled "The Duke of Argyll on the Preservation of the Jews" (pp. 161 to 170), called forth by a remark in his "Reign of Law," in which he said:—"The case of the Gipsies has been referred to as somewhat parallel. But the facts of this case are doubtful and obscure, and such of them as we know involve conditions altogether dissimilar in kind."

To this I replied that "I should not imagine that he knows personally much of either, particularly the Gipsies. His remark is too short, vague, and obscure to admit of any comment being made on it. For a full discussion of the two questions I refer him to the 'History of the Gipsies,' which was published a year before the first edition of the 'Reign of Law' appeared, and two years before the fifth edition, in which corrections were made to meet criticisms on various matters treated in it. I may add that the subject of the Jews is not so well known to the world at large as to justify the many positive assertions that have been made in regard to them" (p. 164).

The same article was appended (pp. 38 to 47) to the "Scottish Churches and the Gipsies," published in 1881. I have not seen any notice taken by the Duke of what I wrote in reply to his remarks about the Jews and the Gipsies. In the Appendix to "Contributions, &c.," under the heading of

"The Endowment of Research," I said:—"On the face of it one would say that the Duke would *not* do any of the following things: 1st, maintain as true what he does not believe to be so; 2nd, advance as truth what he does not know to be fact or fable; 3rd, maintain a personal or popular dogma as a truth until the contrary is demonstrated; 4th, refuse to acknowledge that any position taken up by him is unsound on its being proved to be so, or that there is no reasonable foundation for it; and 5th, allow his opinion to influence others on any subject he may have maintained after it has been proved to be fallacious" (p. 199).

The position taken up by the Duke in regard to this matter is as follows:—"It is not surprising, therefore, that the preservation of the Jews . . . . is tacitly assumed by many persons to come strictly within the category of miraculous events." To this I replied thus:—"Why should that be *assumed*, tacitly or otherwise? What if it is only a 'vulgar error,' started by some person now unknown, and echoed by others after him?" (p. 162). The Duke further said that the preservation of the Jews is "a striking illustration how a departure from the 'ordinary course of Nature' may be effected through the instrumentality of means which are natural and comprehensible."

In the article I went very fully into this subject, and among other things said that "the isolation of the Jews is in exact harmony with the customs and genius of that part of the world where they originated and had their existence as a people, and which has been increased immeasurably by the special genius of their nation, from the call of Abraham, that it was to exist distinct from all others, and continue so for ever. And the Jews have been so persecuted or disliked by other nations that they have never, as a people, had the opportunity of 'amalgamating and becoming lost among others,' assuming that they ever had the wish to do it" (p. 163). "I have discussed the subject pretty fully in the work, showing that the existence of the Jews since the dispersion is in exact harmony with even natural law, and that it would have been a miracle had they ceased to be Jews, and become anything else than what they are to-day, and that there is no analogy between their history and that of any European nation" (p. 161), and particularly owing to them all being "children of Abraham and Sarah." "Paradoxical as it may appear, the way to preserve the existence of a people is to scatter it, provided it is a race totally distinct from those among whom it may be cast, and has inherent peculiarities calculated to keep it separate from others;

and more especially if it is also persecuted, or forbidden or barely tolerated to live among others. Its idea of nationality consists in its existing everywhere in general and nowhere in particular" (p. 162). "It is quite sufficient for the Christian to know that the Jews exist, and that they have fulfilled, and will yet fulfil, the prophecies that have been delivered in regard to them. . . . He should be more considerate in his estimate of what a miracle is, and not maintain that the existence of the Jew is one, for nothing having the decent appearance of an argument can be advanced in support of such a theory" (p. 164).

The preservation of the Jews, in common with that of the Gipsies, is a question of considerable importance, apart from it having been erroneously advanced as a "miracle" in support of Christianity. Neither is an exception to the "Reign of Law," but the strongest point in relation to race or nationality that could be advanced in support of it. The Duke says that his "Unity of Nature" is a continuation of his "Reign of Law," as applicable to Christian Theology. For this reason alone I think that the preservation of the Jews and Gipsies become subjects of not a little interest. In their discussion they should be taken up entirely on their merits, so that "preconceived opinions, prejudices, and dogmatisms" would be out of place in the treatment of them.

New York, February 26, 1884.

V. SCIENTIFIC NOMENCLATURE.

By Frank Fernseed.

SURELY I have fallen upon a dry, dull subject, repugnant to the outsider, and for which even the normal *savant* cares little, leaving the matter by preference to the indiscretion of eminent men. For all this it is high time that something should be not only said, but done. Hence though I have neither the power nor perhaps the right to dictate, I feel bound at any rate to propose and suggest.

I shall begin by admitting that in every science a fixed—and if possible an international—nomenclature is necessary, as well for the objects we study as for the changes they undergo and the operations we perform on or with them. We want names for animals, plants, minerals, chemical compounds, stars, &c., just as we need them for men, towns, or countries. Without such names our observations and experiments are a mere waste of time, since we can neither communicate our results to others, nor even preserve them for our own future reference. Hence, therefore, we need a precise nomenclature. There must be no room for doubt, at distant places or in future times, as to what species or what object our researches refer. One of the chief difficulties encountered in utilising the scientific works of antiquity, or of the earlier ages of the modern world, depends on this very lack of nomenclature.

But here, at the very outset, we meet with a difficulty which splits up the followers of Science into two hostile camps. They will all agree that the names we employ should not be taken from the living language of any civilised nation, since they would thus be *ipso facto* objectionable or useless to other nations. They will grant that our nomenclature should be formed from some dead or dying tongue, which may be the common property of all. Some even restrict this principle, by insisting further that the Greek and Latin languages, and no other, should supply us with the needful material.

The next requisite is that the names of species—organic, mineral, or chemical—should, like the names of stars, be very short. The reason for this is that long names needlessly burden the memory, and occasion much waste of time in transcribing and labelling. One of the greatest educational advantages of the physical and natural sciences, as distinguished from classical and linguistic studies, is that the latter appeal almost exclusively to the faculty of verbal memory, whilst the sciences cultivate mainly the power of observation and of interrogating Nature systematically, and of drawing right conclusions from the phenomena observed. Now the more cumbrous and long-winded we make our nomenclature, the more we sacrifice this advantage, and make Science an affair of memory.

Here, then, the question is raised—What can we fairly and justly demand from the name (say) of a plant, or a fish, or a mineral, or a chemical compound?

To the one party, among which I must claim to be included, the name is merely a mark for identifying the thing.

It serves as a pigeon-hole into which we thrust all our knowledge bearing upon such thing, or a file or clip for holding the whole together. In itself it need have no feature save brevity. If without sacrificing brevity it can be made significant, so as to convey any piece of information concerning the thing named,—for instance its locality, its colour, its habits, or any other property,—so much the better; but I, for one, am quite prepared to sacrifice all "significance" if it can only be purchased by the use of words of ten or twelve syllables.

The other party insist upon it as a something essential that a name shall embody as much as possible of our knowledge, or our opinions, concerning the thing. By so doing they present us with names which few people can remember so as to use in speaking, and which it is even very difficult to transcribe without stopping in the middle and referring to the original. Clerical and typographical errors are thus greatly encouraged.

That "significant" names have some advantages it need not be denied; but, as it has been often complained, these advantages are too dearly bought. To take a parallel case, it might often be convenient if the name of a man revealed to us the place where he was born, the maiden names of his mother and his grandmothers, his political and his religious creed, his balance at the bank, &c. But as a name to effect all these purposes would be exceedingly cumbrous, we find it simpler to call the man John Smith, understanding, rather than expressing, all such points as we know concerning his pedigree and his other attributes. This is every way more convenient, and a less strain upon our memory. Why should the case be different with, *e.g.*, chemical compounds?

It must be had in remembrance that the information conveyed to us in a "significant" scientific nomenclature consists generally not so much of facts as of opinions and theories. Time then rolls on, theories are laid aside, and a new name becomes necessary. This constant re-baptizing of objects is a serious hindrance to the spread of sound knowledge. The worst case is when a name is taken away from one body and applied to another. As an instance I may mention the salt sodium hyposulphite, familiar to photographers. This name has been confiscated and handed over to the compound which Schützenberger and De Lalande had named sodium hydrosulphite, and which they used, *e.g.*, in the reduction of indigo. Meanwhile the original hyposulphite is dubbed sodium thiosulphate. Suppose, then, we

find in a chemical work, or in a memoir, some mention of "sodium hyposulphite," we do not know which compound the author means. We may have to consider the date of the book, and reflect whether, according to our former knowledge of him, the writer accepted or rejected this change in nomenclature. If these clues are wanting, we have then to judge which body is signified by our knowledge of its properties. Thus, in fact, the main advantage of a precise scientific technology is sacrificed to the rage for "significant" names.

I must, however, not forget that to one class of minds such revolutions are welcome. Certain authors are immediately engaged in translating the old matter into the language of the new theory, and can thus acquire a certain reputation without discovering a single fact or making in any way the slightest addition to the sum of human knowledge.

In sciences where nomenclature does not depend on theories such troublesome changes are avoided. The astronomer applies still to the planets and the fixed stars the same names that were used in the pre-Newtonian or the pre-Copernican times, new appellations being needed only for heavenly bodies since discovered. This permanence in terminology is rendered possible by the fact that these names are not linked to any theory, and aim merely at identifying, not at defining or describing, their objects.

In Chemistry, as I have already intimated, a long, cumbrous nomenclature, intended to define rather than simply to mark out, has reached its greatest height, and become a crying evil. This circumstance is perhaps due in no small part to the fact that the modern development of the science, especially of that portion which deals with the compounds of carbon, has been chiefly in the hands of the Germans. This nation, not merely in scientific matters, but in the affairs of common life, seems to delight in a long-winded, sesquipedalian nomenclature. Their books, their journals, their societies, the titles of their officials, &c., have names disagreeably long for quotation or reference. Where we and our American kinsmen are content to identify, they still seek to add all manner of circumstances. What wonder that they have carried the same habits of thought and the same principles into their chemical nomenclature?

In Mineralogy, though many defects are to be recognised, yet upon the whole a healthier spirit prevails. A new insight into the composition of a mineral does not necessarily lead to a change of name. The names, too, are for the

most part free from any attempt at significance, and consequently can suffer little from any change of theory.

We come now to the organic sciences, where the wonderful changes wrought out by Darwin and his coadjutors have so far not been thought to involve a re-naming of the entire vegetable and animal kingdoms. The so-called binary nomenclature, commonly ascribed to Linnæus, is really due to Pierre Belon, of Mans, who laid down its principles as early as 1558. But there is a feeling "in the air" that this system has had its day, as not lending itself to the discrimination of sub-specific forms. We must indeed admit that, with all its advantages, the Linnæan system is better adapted to the hypothesis of permanent and unalterable species than to that of ever-changing forms. Let us hope, however, that when—if ever—the new nomenclature is constituted it will not be built upon the lines of the supposed evolutionary pedigree of each species. *Equus caballus* may not be a faultless name for a horse; but suppose in its stead one in which *Orchippus*, *Anchitherium*, and *Hipparion* are interwoven, every additional step in research involving a re-naming!

In the meantime the rage for significant names has made itself felt as regards more recently discovered species, and with the necessary results. The older names connote nothing, and simply denote the genus or species to which they are applied. Thus no one, save perhaps a philologist of the calibre of Prof. Max Müller, can find any meaning in the word *Rosa*. Yet it makes as good a generic name as does *Trigonogenium*, *Tmesorrhina*, or *Dicranocephalus*, and is much more easily pronounced and remembered.

I cannot sympathise with those who think every name of origin other than Greek or Latin should be necessarily excluded. Why, for instance, was *Moa* not permitted to remain as the generic name of the gigantic extinct bird of New Zealand? It is shorter and much more euphonious than the Greek word *Dinornis* which has been coined in its place, and, belonging to none of the "culture-tongues," might have been accepted in all countries. On the other hand, *Dinornis* has indeed a meaning,—"dreadful bird,"—but, as is often the case, one which tells us nothing concerning the locality, the habits, or other properties of the species.

I heard with surprise and regret, a few evenings ago, an eminent entomologist complaining that names taken from Hindu mythology had latterly been given to Indian insects. With all due deference I cannot enter into his feelings. These Hindu names are well marked, easy to remember, and if applied to species inhabiting the Oriental Region

will at once mark their locality. On the other hand, I can most cordially protest against some recent barbarisms. When a writer concocts such names as "*Darwinhydrous, Tyndallhydrous, Huxleyhydrous,* and *Spencerhydrous,*" we may well ask, in alarm, what next? The answer is perhaps supplied by the American entomologist who named an unfortunate beetle *Carabus know-nothing*.

But besides the names given to genera and species, some of a highly complex and ultra-classical character have lately been introduced into various departments of Biology. Surely a movement of this kind is a mistake when an increasing number of persons are studying Natural Science who are not classical scholars. No less surely the mistake is intensified if such words are introduced by an eminent official *savant* who opposes the predominance of classicalism in higher education, and yet by manufacturing such words makes it almost compulsatory. Needlessly to multiply technical terms of *any* origin is, I submit, a grave error. It is sad to see an able morphologist using such terms as "caudad," "cephalad," and the like, when tailwards, headwards, &c., would express his meaning as precisely and more intelligibly.

It will not, I trust, be thought an aimless digression if I call attention to the confusion which may arise from the use of one and the same term in various branches of Science with a different meaning. As an instance we may take the term "function," used both in Physiology and in Mathematics. In the former, or rather in Biology generally, function is the particular work performed by some organ or tissue. Thus the decomposition of carbonic acid under the influence of light is the function of the chlorophyll granules of plants; respiration is the function of the lungs, the gills, and the tracheæ of animals, digestion of the stomach, &c. In Mathematics, on the contrary, a quantity is said to be a function of another, or of several others, when its value depends upon that or those of the latter.

Such terms very rarely occasioned any ambiguity in former days, when the different sciences stood more isolated and more aloof from each other; but now they supply each other not unfrequently both with facts and methods, the confusion is beginning to be felt. Thus since quantitative determinations have been more and more introduced into biological researches, we may in them meet with the term "function" in its mathematical sense.

A similar confusion may arise with the term "elements." Thus we have the "elements" of Chemistry, the undecom-

posed and assumed undecomposable bodies; in Astronomy "elements" are the data necessary for ascertaining the place of a planet or comet; in Electricity an "element" is a unit of a galvanic combination, &c. Many more such instances might be sought up if it were needful to furnish a catalogue.

There are two words, not strictly belonging to scientific nomenclature, which should here be considered; both have outgrown, or rather have grown away from, their original meanings, and hence call for a re-adjustment.

The word "museum" is now, in England, applied to two classes of establishments which, save the name, have very little in common. The one class is simply Wardour Street on a magnified scale. It is fitted with objects of human production, and illustrates the career of art, "fine" or industrial, and the waverings of fashion.

Museums of the second class are destined for the reception of specimens illustrative of some science, and which are, or might have been, the products of Nature. Class I. receives old furniture, bric-a-brac, clothing, pictures, statues, idols, weapons, and the like. Class II. is for geological, mineralogical, botanical, and zoological specimens. As a rule it will be found that the persons who take an especial and a thoughtful interest in the one kind of museum will care but little about the other. The mere holiday sight-seer alone will stroll through both as he hastens to his great attraction, the refreshment-room—that recent and injudicious appendage to museums.

It may, however, be said that articles of human production illustrate, at any rate, one Science which of late years is receiving great and wide attention throughout the civilised world. This is true: articles of "bigotry and virtue" may be viewed as ethnological, or indeed as anthropological, documents. But whilst admitting the difficulty here, as in all our classifications, of drawing a hard-and-fast boundary line, I would suggest one which may be adopted for the sake of convenience. Let all products of pre-historic art be referred to the Museum of Science,—all of a later age to the Museum of Art and Industry.

We need, then, two distinct words for museums of these two classes, to save the necessity of explanations.

The other word to which I refer is Aquarium. This name was first given to receptacles of water, large or small, in which the development and life of aquatic plants and animals might be conveniently studied. So far all was well, the only question being whether Aquarium or Aqua-vivarium should be accepted as the correct term. John Bull's craving

for brevity in language (a laudable feature!) for once carried the day against his love for classical precision, and Aquarium became the accepted term.

But now came the misfortune. Such a receptacle was found to have its entertaining as well as its instructive phase. The small Aquarium, from an appliance for the laboratory became an ornament for the drawing-room or the boudoir. The large Aquarium was seized on by speculative individuals or companies as an "attraction," and, in conjunction with other "attractions," was worked up into totalities differing very little from music-halls or "palaces of pleasure."

The typical English aquarium is no place for study, save that of human frailty; its fishes are chiefly of the order familiarly known as "loose," and its water is mainly, for internal consumption, qualified with alcohol. Promenade concerts, dances (I believe), and the feats of jugglers are offered in place of facilities for observation and experiment. In short the term has undergone a transformation as signal as did the word "bagnio."

Now I do not presume to dictate what should be the pursuits of my neighbours. But there is, I submit, good cause to complain if amusements of such a nature are carried on in places nominally at least devoted to Science. It is not well that one and the same name should be applied to such establishments as that of Professor Dohrn at Naples, or that at Watson's Bay in New South Wales, on the one hand, and the present English aquariums, on the other. We may, indeed, call the original unpolluted Aquarium a "Marine Zoological Station," or some such cumbrous name. But we want a brief compact word. Can none of our neologists coin a suitable term?

VI. ON TECHNICAL EDUCATION.

By ROBERT GALLOWAY, M.R.I.A.

(Continued from page 159.)

THE system of Technical Instruction carried out by the City and Guilds of London Institute will now be reviewed: the system is a copy of the Department's one in its general principles; all the errors and defects of the one system exist consequently in the other. The teacher is paid wholly on result system; the Examinations are merely written ones. The same set of Examiners appear always to be employed, as is the case under the Department; therefore what has been stated in former articles in condemnation of this mode of paying teachers, and testing the *quality* of the instruction given as adopted by the Department, applies in an equal degree to the Guilds' plan.

In the Guilds' Programme it is stated that the "Payments to teachers of Technological subjects, on the results of instruction in Technology, will be made generally in accordance with the same rules as those which regulate the payments made by the Science and Art Department to Science teachers,"—that is to say, the teacher will not receive payment on results for every class of students, but only for those who are in receipt of weekly wages, and of their children, or persons in the receipt of not more than £200 a year, also their children, and teachers and pupil-teachers of some elementary schools. We draw attention to this *limitation* in the payments, because we shall bring under the notice of our readers presently the opinions of men eminently qualified from their occupations to form intelligent and correct views on the question, and it will be shown that their opinions do not accord with those who were the originators of this system.

Local Committees along with the Local Secretaries superintend the pupils, as under the Department's plan, during the time they are engaged in answering the questions set in the Examination papers. The Guilds do not, however, appear to have any inspection of their classes to see how the courses of instruction are given by the teachers, and yet, as was shown in the May article (vol. v.), this duty is a most important one, for good inspection will reveal more as

to the kind of instruction given in a school than the mere perusal of Examination papers. It was pointed out in the last article that the Department entrusted this important duty—*viz.*, the Inspection of their Science Schools—almost entirely to Officers in the Army.

Let me show my readers how authorities like the present Vice-President of the Science and Art Department, the Right Hon. A. J. Mundella, M.P., regard it. In his Examination before the Select Committee of Scientific Instruction, in 1868, he was asked the following question (4704):—"Are you aware that only about *two-thirds of the sums* granted for educational purposes are really disposed of for those purposes, *the rest* being absorbed in the Staff of the Establishment?" * Answer: "It is not to be wondered at, if you look at our Inspection: we have three or four classes of Inspectors, when one would do the work." In answer to another question he indirectly intimated what he thought of the quality of this Inspection by speaking in contrast with it of the excellent quality of the Inspection in German schools. But before giving the questions and answers it will be as well to inform my readers that Mr. Mundella, at the time he gave his evidence, had not only a large manufactory devoted to the hosiery trade, at Nottingham, but he had also a similar one at Chemnitz, in Saxony, where he employed between 700 and 800 hands; he was therefore well qualified as a manufacturer to express his opinion on the difference between the educational systems in the two countries. Question (4706): "Apart from the question how the Inspection should be conducted, do you not think that Inspection by a central authority is useful?"—"I think it is very useful and desirable." Question (4707): "Would that apply, in your opinion, to primary education alone, or to scientific instruction also?"—"Yes. In Germany even private schools must be inspected by the Government Inspector, who has to see that *no quack* assumes the office of teacher of middle-class schools, and the result of this system of inspection is that the inspection in Germany is *first rate*." I will here give one more question he was asked, and his answer, as the answer very strongly confirms some of the statements in the

* It is difficult to arrive at the exact sum expended on the administration, including the cost for Examinations and Inspections, in contrast with the teachers' payments (the payments on results) from any of the Department's documents on the subject. But as far as I can make out, after a very careful examination of the Estimates, the Appropriation Accounts, and other available public documents, I believe I am correct in stating that it is not two-thirds of the sums granted for educational purposes that is expended at the present time on those purposes, but that it is less even than 50 per cent.

last article. Question (4794): "What you would wish is that the English manufacturer should have the same advantage as the foreign manufacturer in scientific education?"—"Yes; and if he has those advantages I am sure he would hold his own." One of the Science teachers under the Department who gave evidence before that Committee said, with regard to the Inspection as it was conducted, that it was practically useless.

With three exceptions all the eminent manufacturers, including Mr. Mundella, who gave evidence before that Committee, and also the Professor of Engineering in the Edinburgh University, Fleeming Jenkin,—who before he was a professor had been both a mechanical and civil engineer in practice, and had carried out engineering works on the Continent,—all testified that it was not from want of skill on the part of our artizans, but from want of scientific and artistic knowledge on the part of our manufacturers, their managers, and foremen, that foreign manufacturers are equalling and will eventually surpass our own, unless these classes in England are supplied with a scientific and artistic education equal to that obtained by like classes on the Continent. The Committee stated in their Report—"There is a preponderance of evidence to show that so far as the workmen, as distinguished from the managers, are concerned, scientific knowledge can be considered an essential element only in certain trades, or, generally, as enlarging the area from which the foremen and managers may be drawn." Nearly every one of the witnesses attributed the extraordinarily rapid progress of Continental nations in manufactures, not to their model workshops,—for they considered these workshops but an indifferent substitute for our own great factories,—but mainly to the scientific training of the proprietors and managers in France, Switzerland, Belgium, and Germany.*

All the witnesses concurred in desiring similar advantages of education for this country, and were satisfied that nothing more *was required*, and nothing less *would suffice*, in order that we may retain the position which we now hold in the

* Mr. Bernard Samuelson, M.P., Chairman of the Royal Commission on Technical Education, stated a short time ago—"One of the great fallacies which prevailed was that foreign *workmen* were better educated than our own. In France and Belgium the education of the workman was spread over a larger area than it was with us, but the remark did not hold good with respect to other countries, even with regard to Art; and to suppose that the average workman on the Continent was receiving a superior technical education to that of the workman of this country was a mistake altogether, and ought not to be allowed to go uncontradicted.

van of all industrial nations. All were of opinion that it is of incalculable importance economically that our manufacturers and managers should be thoroughly instructed in the principles of their arts.

They were convinced that a knowledge of the principles of Science on the part of those who occupy the higher industrial ranks, and the possession of elementary instruction by those who hold subordinate positions, would tend to promote industrial progress by stimulating improvement, preventing costly and unphilosophic attempts at impossible inventions, diminishing waste, and obviating in a great measure ignorant opposition to salutary changes.

On the payment part of the question the Committee observed—"The remuneration of the teachers, arising from pupils' fees and payment on results by the Department of Science and Art, is, with few exceptions, *so scanty* that Science teaching is scarcely ever followed as a profession, but only as an addition to some more profitable employment. Hence classes are frequently suspended whenever the more important occupations of the teacher demand increased attention, or cause him to remove to other localities. As the demand for instruction increases the incomes of the teacher will doubtless increase likewise, but the want of competent men will still remain."

It is not from want of competent men, nor has it ever been so, that we have not had good scientific instruction given in the Science classes under the Department of Science and Art; it is, and has been, due to other causes. We will briefly enumerate a few: uncertainty as to what will be awarded for the labour and time given; uncertainty in the date of payment, when an award has been made; uncertainty in the duration of the employment, for under the system the teachers are entirely in the hands of the permanent officials at South Kensington: there is no appeal from their decision, however unjust, and those decisions may be made by some subordinate clerk in the Department. The result system, in fact, makes the teachers the servants of the permanent officers of the Department, and not the servants of the State. In the Department's Annual Reports it is always prominently put forward that Science schools continue to multiply, and that there is a continued increase in the number of pupils; therefore in this sense Science instruction has increased since the Committee reported, but, instead of the incomes of the teachers increasing, as the Committee expected, their average payment has decreased since that time by more than 38 per cent. Again, it is

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within the power of the permanent officials, according to their Minutes,—Minutes which, according to Mr. Mundella, are rather *puzzling*,—to award no pay whatever to the teacher after he has given his course of instruction; but if he is awarded pay it may, as we have seen, be so *scanty* that it may not amount to $2\frac{1}{4}d.$ per hour during the time he is occupied. The cost of the administration of the Science and Art Department—the Staff establishment—has in the meantime gone on increasing at a rapid rate, including the secure and permanent salaries of the officials; and new posts, to which handsome salaries are attached, continue to multiply. Is there not a cause, then, why competent teachers should not place themselves in such a humiliating and precarious position? Private employers could not obtain competent persons on any such terms; neither as a rule can the State obtain them.

But competent teachers are not able to teach efficiently under the system, for if they did they would earn little or no pay: "Science Teacher," in his letter which appeared in the last number of this Journal, states that fact, and Science teachers I have met with have stated the same thing to me. One of the Department's own Inspectors, in speaking to me some time ago on the subject, informed me that the most successful of the Irish Science schools he inspected—the most successful in the way of obtaining medals, prizes, &c. —the pupils were prepared by repeating answers every school-day to a certain number of the questions the Professional Examiners had given in previous examinations: in the course of the conversation he observed that it would be much better, instead of expending public money on the teaching of subjects which never could be of any use to the learner, owing to the way the subjects were taught, if the money was expended in teaching the young people some handicraft which would be not only of benefit to themselves but also to the country.

I have noticed these evils as they form part of the system; they must therefore, in a greater or less degree, pervade the system when carried out by the City Guilds.

The limitation of Science instruction, on the part of the Department and the Guilds, to the artizan class chiefly, is limiting it to the class which can least benefit by such instruction. Mr. Mundella, on being asked questions by the late Lord Frederick Cavendish, showed by his answers that he had no doubt as to the class to be taught if the nation was to derive any benefit from the instruction given. 4664: "Do you think it is necessary, in order to enable us

to maintain competition with other countries, that all persons employed in our manufactures should have some scientific education, or that such scientific education is chiefly necessary for manufacturers, managers, and foremen?"—"I think it is necessary *simply* for manufacturers, managers, and foremen." 4665: "You do not think it is necessary that ordinary mill-hands and mechanics should receive such instruction?"—"It is not necessary, certainly." The following question and answer shows what he thought of the *quality* of the instruction given under the Department of Science and Arts system, and the same will of course apply to the City and Guilds plan. 4635: "In Nottingham have you many classes in connection with the Science and Art Department?"—"Only two or three very small classes; you may call them Elementary Science classes: they are doing good work *I dare say, but there is no comparison between them and the Science instruction given abroad.* The scientific instruction given abroad is really solid instruction, but what we give at our mechanics' institutes, in a chemical class attended by about thirty persons, which is the only class in Science, is not instruction *of the same order.*

The witnesses recommended the continuance of evening Science classes; but the continuance of these classes was recommended far more for the sake of those who were or would be masters, managers, or foremen, than for the artizan class. They were very strongly of opinion that artizans, with the exception of a very small minority, would be unable, owing to the *exhaustive* toil they had to undergo during the day in the workshop or factory, to attend, at least with any benefit, to instruction given, especially if the subjects to be studied were of such an ever-progressive nature as those of the inductive sciences; they considered it was somewhat different if the subjects were of a comparatively non-progressive character, like mechanical drawing: drawing they considered might be studied with advantage by artizans.

The framers of this educational system for artizans—for when it was first started by the Department it was limited exclusively to that class, if we are to take the Department's puzzling Minutes as our guide—altogether *overlooked* that the energy each person possesses is *limited in quantity*, and therefore, as the artizan's energy is all or nearly all used up in the manual labour he performs during the day, he has consequently little or none left to draw upon for serious and exhaustive mental study in the evening: he likewise labours under another difficulty,—the education he received in his school-boy days was limited in quantity, and not unfrequently

very indifferent in quality. The mere learning scientific facts, such as that phosphorus will burn in oxygen, will be of no practical advantage to artizans or any other class: chemical science, for example, to be of any practical benefit to the taught and the community, must be carried far beyond such mere rudimentary teaching; and as the science is continually progressing, and at a rapid rate, the taught must ever continue the study—both in the laboratory and by study of the advanced chemical works—both on pure and applied science; it is too frequently left out of sight that the inductive sciences are ever progressing.

Prof. Fleeming Jenkin, in the *invaluable* evidence he gave before the Select Committee, said—"I do not see how a practical knowledge of Chemistry is to be of use to workmen who are employed to carry out manufacturing processes. It is impossible that they can have such a knowledge of the theory of Chemistry as would enable them to alter or modify the processes in any way; and I should think a little knowledge would be almost objectionable, if they were allowed to use it for such a purpose." Prof. Jenkin was speaking of the average workman, and I quite agree with him. A most valuable and instructive educational experiment, which was noticed in the April No. (vol. v.), has been tried at the Cornell University in America. It is this,—whether a student can work part of the day at manual labour, and part of the day at mental study, with success in the latter labour: the experiment has proved it to be impossible with the average student, for he has not sufficient energy for both mental and manual toil.

The quality of the instruction given both in the Department's schools and the Guilds' schools requires to be very greatly improved; instead of *quantity* being the primary object, as is the case at present, let *quality* be the first desideratum aimed at in the future: to gain this improvement it would be desirable to restrict the evening Science classes to towns in the first instance, and afterwards extend them to villages when required. Let the capitation fees, along with the students' fees, be sufficient to afford a competent teacher a respectable salary; let the maxim attributed to Confucius be adopted in the future with respect to the teachers—"If you suspect a man do not employ him, and if you employ him do not suspect him." In connection with this part of the subject I will quote one other remark made by the Commissioners: "There can be no doubt," they state, "that from the evidence of Mr. Mundella, of Prof. Fleeming Jenkin, Mr. Kitson, and others, and from numerous

reports of competent observers, that the facilities for acquiring a knowledge of theoretical and applied science are incomparably greater on the Continent than in this country, and that such knowledge is based on an advanced state of secondary education."

The Grammar schools in the country parts of England, especially those that have no scholarships or prizes to give away at the Universities, should be converted into schools where a modernised system of education was given, somewhat similar in character to the course given in the Real schools in Germany; and let some of the most talented boys in the National schools in the neighbourhood be promoted from time to time into these higher Middle-class schools, on a plan somewhat similar to that adopted in Germany. In this way the disadvantages the boys in sparsely inhabited districts might labour under, as regards educational training, compared with the boys living in towns, would be considerably overcome.

But we must return to the more immediate subject of the article, *viz.*, the City Guilds' scheme as regards evening classes, or perhaps it would be better to enlarge it by saying their elementary classes.

The City and Guilds confine themselves to Technical Education: it is unfortunate that this term "Technical Education" has more meanings than one attached to it: some people confine the meaning to the teaching of trades and handicrafts; others limit it to the teaching of Science and Art in their applications to different industries. It is mainly in the latter sense that it is employed by the City Guilds, although they appear in some cases perilously near entering upon the teaching of trades.

As regards the teaching of trades in schools, there are few trades that admit of even a semblance of being taught; the manufacture of sulphuric acid, soda ash, bleaching powder, the melting of ores,—in fact all our most important industries,—could not be taught in scholastic factories or workshops.

Moreover, the teaching or the attempt at teaching trades to the artizan class—for they would be the only class that would undergo the necessary manual labour attending such instruction—would very strongly tend to perpetuate one of the very serious evils we are suffering from as an industrial nation at the present time. For if the owners, or those who would in the future be the owners, of manufacturing establishments were led to believe that they could be supplied with trained workmen, however mechanically they

were trained, from institutions like the City Guilds, it would conduce very strongly to make them indifferent in learning the principles of their art; they would content themselves, as at present, with being *mere employers of labour*, leaving to others the acquiring of a knowledge of the principles on which their industries were based. And yet it is most desirable, for the owner's and nation's success, that he should have a sound knowledge of the principles on which his industry is based, for it would render him more earnest in his business, and it would much contribute to make him give personal attention to every detail; and according to Mr. Chance, the large glass and chemical manufacturer at Birmingham, "success in any manufacturing pursuit depends mainly upon the most minute attention to the smallest point which may be concerned in the perfection of the article to be produced, and that is why I think thoroughness of education is so important: a man who has had a thorough education will appreciate perfection much more than the man who has been superficially educated." A sound knowledge of the principles of his business also causes the manufacturer to take a greater pride in his employment, and it makes him keep himself better informed as to what is being done in other countries.

Mr. H. Ripley, the then Chairman of the Bradford Chamber of Commerce, insisted strongly before the 1868 Committee on a good scientific education for owners and managers, on account of advantages like those named that spring from it. I will give one question and his answer. Question (4267): "Comparing them (French and German manufacturers) with English gentlemen of the same order, do you think they are on the whole more intelligent, particularly on scientific subjects, than a similar class in this country?"—"I expressed an opinion on that subject years ago, and I expressed it again very strongly last year at Bradford, in the spring. I have come in contact with manufacturing gentlemen abroad whose friendship I could claim, and, from my point of view, these men are superior in scientific knowledge to gentlemen of a similar class in England; they are undoubtedly superior in scientific knowledge to any men occupying similar positions in England; they have appeared to me to be more in earnest than our manufacturers are on this subject, and I am ready to use the word "alarmed": the only thing that has alarmed me is the earnestness with which these foreign manufacturers are conducting their business, and the attention they give to every point of detail: comparing them with our own

manufacturers, I see a great want of earnestness here in many cases.

The number of students who were examined in Technological subjects by the City Guilds amounted to 1972 in May, 1882, and to 2397 in May, 1883; the cost of the examination of the students in May, 1882, is set down at £2378, or £1 4*s*. per head. In the Programme for 1881-82, the last I have got, the subjects to be examined upon amounted to 32; they include not only all kinds of manufacturing processes, but such subjects as bread-making, plumbers' work, silversmiths' work, watch- and clock-making, &c.

The Guilds place a very curious *limitation* on paying on results: to make this clear to my readers I will quote from their Programme:—"The students, on the result of whose examination the grants will be made, must be persons actually engaged in the industry to which the examination refers, or in some closely allied industry. They will be required to obtain their employers' signature to a form testifying to this fact." The Guilds do not therefore, for example, give a complete technological chemical course, but they teach, or attempt to teach, the chemical principles involved in alkali manufacture to those who are engaged in alkali works, the principles involved in gas-making to those who are engaged in gas works, &c.

Do the City Guilds intend to have this limitation in their higher scientific schools or colleges? if not, on what principle do they carry out this limitation in their Elementary schools? The limitation would almost seem to imply that they think there is a different chemistry for each particular manufacture. I, and others who like myself have carried out original investigations in chemical factories, and have also had *actual* superintendence of chemical factories, and large and varied experience in teaching the science in the laboratory and lecture-room, do not think students gain very much real knowledge by attending even complete technological courses in Chemistry. For if the student has received a very sound and thorough course of instruction in the laboratory—and still more, if he has received a training in conducting chemical investigations—he has the same means of access, with *equal knowledge*, to the sources of information of Chemical Technology, as his teacher, especially if the teacher has had no practical experience in any chemical factory, and whose chemical technology teaching is therefore limited to what he has gained from books and from *visiting* chemical factories. But when the technological teaching is

limited to the industry in which the student is engaged, as it is under the City Guilds system, it may be classed almost correctly as "rule-of-thumb teaching."

Prof. Bayer, the first discoverer of the mode for producing artificial indigo, when asked by our Technical Commissioners how long he would recommend that a technological student should be engaged in studying and working at theoretical chemistry during his studentship, replied, "I would make it firstly chemistry, secondly chemistry, and thirdly chemistry." In other words, if the science has been thoroughly grasped, the applications will take care of themselves, for the student who has been so trained and instructed in the science is rendered competent, as far as instruction will,—for instruction cannot endow a man with ability to apply his knowledge, who has no natural talent for applying it,—to apply his knowledge *not to one but to any* chemical industry.

But the *limitation* is not the only blot in the City Guilds elementary course; another and very serious defect is the very small modicum of science they require on the part of the student they undertake to instruct in Technology. I will here reproduce what I have stated on this part of the subject in my work on Education, "Scientific and Technical." I believe the Technical Examinations that are being carried out by the City Guilds of London Institute are not likely to prove of much, if of any, advantage to the country. I allude to the examinations in such subjects as brewing, calico-printing, the smelting of ores, &c. Their inutility will arise not on account of any deficiency in the divisions of the subjects examined upon, nor from the questions given, but from the slender stock of knowledge that is required for passing them: thus for the full technological certificate for brewing, it is required of the candidate that he has previously passed—at least in the *elementary stage*—one of the following subjects at the Department of Science and Arts examinations:—

Machine Construction and Drawing.
Building Construction.
Theoretical Mechanics.
Applied Mechanics.
Inorganic Chemistry.
Organic Chemistry.

Of these six subjects only the last two would be of use in passing the examination on Brewing, as given in their Programme of 1880; and the majority of the students who pass the Department of Science and Art examinations—at least

in the elementary stage—have no practical knowledge of the sciences they pass in; they have acquired their knowledge generally, not by studying the science practically, but from books or lectures; it is consequently not a knowledge *of things, but only of names of things.* It appears to me that in both sets of examinations, *viz.*, those in Pure Science and those in Applied Science, to use the words of Prof. Williamson, "It is just wasting the time of students, instead of doing that which really might be of permanent use to them; and they are sent out as conceited fellows, who are simply a nuisance to the factory, if they do work in it, instead of modestly beginning to learn the practice at the bottom."

Sir William Thomson stated before the Committee of Scientific Instruction—"I have a general feeling that a Chair of Technical Chemistry has nothing to teach that is not better learnt in a manufactory. There is only one Chemistry, and that is *true Chemistry;* and it is much more desirable, therefore, for those who are going into a chemical manufactory to know true Chemistry than that which would be of the most trivial value to them,—namely, to have attended courses of lectures upon the processes of calico-printing and bleaching, and the manufacture of colours, elaborately described, with illustrations, which the students are better able to see in the workshop."

(To be continued.)

Note to Article on VACCINATION *in our last.*

* These high percentage figures have been taken as proof that the epidemic of 1871-2 was of exceptional severity; but they are simply a statistical delusion, or, rather, the statistical proof of the existence of a delusion, seeing that no more die in the total than before. To illustrate:—In 1871-2, the proportion of vaccinated to unvaccinated patients is given as 75 per cent, with a total fatality of 19 (18·66) per cent. The relative fatality of unvaccinated to vaccinated is represented as four to one, giving percentages 44·8 and 10·15. Now, if the proportion of vaccinated to unvaccinated patients became 90 per cent while the total fatality, and the relative fatality of the two classes, remained the same, the percentage fatality of the two classes would appear as 60 and 15 respectively, although all the actual conditions affecting mortality continued unaltered. If the proportion of vaccinated patients, under the same conditions, were raised to 95 per cent, the percentage figures of the two classes would then be 68 and 17. Contrariwise, if the vaccinated declined to 10 per cent of cases, the corresponding fatalities would appear as only 20 and 5.

G. S. GIBBS, F.S.S.

ANALYSES OF BOOKS.

Coffee and Tea. A Lecture given at the Parkes Museum on December 6th, 1883. By G. V. Poore, M.D. London: H. K. Lewis.

In these reforming days coffee and tea are pronounced no less pernicious than wines and malt liquors. Even a draught of spring-water is forbidden us, and we are told by meddling innovators that hot water, heated just so strongly as not to prove an emetic, is to be the "drink of the future"—poor future! Dr. Poore, however, has the courage not to regard this clamour. He speaks out boldly in praise of tea and coffee, and does not even pass a sweeping condemnation on alcoholic beverages. He tells his hearers that a properly controlled appetite or instinct is as safe a guide in the matters of diet as a physiologist or a moralist. Safer by far, we should add, than the latter! We read here further:—"The argument is often put forward that as the lower animals do without tea, coffee, &c., so ought we; but to this I would humbly oppose the fact that we are *not* lower animals, that we have *minds* as well as *bodies*, and that since these substances have the property of enabling us to bear our worries and fatigues let us accept them, make rational use of them, and be thankful."

We should be the last to maintain that a regimen fitted for one species is all sufficient for another. We fully recognise the fact that man—modern man, and perhaps most of all English and American man—has, by a *curiosa infelicitas*, placed himself in abnormal conditions, so that what is natural is no longer the question. Perhaps when the "equal rights" of the lower animals have been acknowledged,—when "national conscience," *i.e.*, the exigencies of party, has led to their enfranchisement,—and when they have been handed over to the tender mercies of the Committee of Council on Education or the Science and Art Department, they too will find the necessity of tea, coffee, or even hashish. Meantime we submit that, like ourselves, they have "minds as well as bodies."

Dr. Poore describes the peculiar physiological effects of tea and coffee, and shows how completely they differ from those of alcohol. He discusses the relative dietetic value of a cup of tea as compared with a cup of coffee, pronouncing the latter to have double the value of the former. But this conclusion is based

upon German researches, and everyone knows that the infusion known in Germany as "Thee-wasser" is exceedingly feeble.

We find here due mention of tannic acid as one of the dangers of tea, especially for the poorer class of consumers. Anxious to extract anything of value from a modicum of tea, they allow it to "simmer on the hob for an indefinite period, with the result that a highly astringent and unwholesome beverage is obtained. There can be no doubt that the habit of drinking excessive quantities of strong astringent tea is a not uncommon cause of that atonic dyspepsia which seems to be the rule rather than the exception among poor women of the class of sempstresses." It is evident that the use of a solution of tannin along with albuminous or gelatinous matters is a royal road to indigestion. The "tea-dinner," or "high tea," is a grievous mistake.

Coffee, however, is the author's main subject, being of the two articles the less understood in this country. He points out that it should never come in contact with metal at all. It should be bought not merely unground, but raw, kept for use in a stoppered glass bottle, roasted in an earthenware pipkin, pounded in a mortar with wooden pestles, and prepared in a stoneware pot. With the exception of the pounding in place of grinding—a process peculiar to Turkey—these are the rules followed on the Continent. Brillat-Saverin is here quoted as having made a careful experiment to test the comparative virtues of grinding and pounding. He carefully roasted a pound of good Mocha, and divided it into two halves, grinding the one and pounding the other. A jury of gourmets decided that the decoction made from the pounded portion was superior in flavour and aroma.

We thoroughly agree with Dr. Poore in his repudiation of chicory. It was an evil hour when, at the instance of one of whom it has been said that he was, "as touching the righteousness that is in red tape, blameless," the sale of coffee mixed with chicory was officially sanctioned. But into this subject we cannot enter. It may be well to glance at the scandalous falsehood of "Coffee as in France, a luxury unknown in England." In France people buy their coffee unground, very generally unroasted, and roast and grind every morning for the day's consumption. Those who use chicory add it themselves in known proportions, and are not simple enough to buy chicory worth (say) 3½*d.* per lb. at the price of coffee.

This lecture contains instruction greatly needed by the British public, and we hope it will lead some of its readers at least to desist from the stupid practice of buying ground coffee.

Proceedings of the Literary and Philosophical Society of Liverpool (during the Seventieth Session, 1880-81). No. XXXV. London: Longmans and Co. Liverpool: D. Marples and Co., Limited.

FROM a variety of causes, into which we have no occasion to enter, this volume is somewhat late in making its appearance.

Of the memoirs printed three only, or at most four, come within the legitimate scope of our cognizance.

That the Inaugural Address of the President, Mr. E. R. Russell, concerns us little may be readily expected if we call to mind an utterance of his contained in an Essay on "Trevelyan's Life of Macaulay." The subject of the Address is "The Independent Prerogative of the Understanding in the Domain of Moral Judgment."

A memoir on the "Dimensions of the Stellar Universe," by R. C. Johnson, F.R.A.S., is a summary of existing knowledge rather than a record of newly-discovered facts or of original generalisations. The author's objects are to explain the difficulties which baffled all attempts prior to the invention of the telescope, to ascertain the distances of the stars, to describe what is known concerning the stars so measured, and, lastly, to show how from this knowledge there is being gradually elaborated "a scheme that may possibly comprehend the physical connection of remoter stars and systems." These points are expounded with clearness and ability.

A paper by the Rev. Thomas Hincks, F.R.S., "On a Collection of Polyzoa from Bass's Straits, presented by Capt. W. H. Cawne Warren to the Liverpool Free Museum," records good original work. This collection was placed for examination in the hands of Mr. Hincks, well known as one of the greatest living authorities in this department of Zoology. It contains no fewer than 90 species, of which 23 are new to Science. Hence the author infers that in those regions much remains to be done. Twenty-two of the species are, it appears, common to European seas, but a large proportion of the remainder are peculiarly Australian.

Another paper of merit is a description, by H. J. Carter, F.R.S., of Foraminifera and Sponges dredged up by Captain W. H. Cawne Warren in the Gulf of Manaar and in Bass's Straits.

A number of papers are simply mentioned in the Contents or briefly noticed in the Proceedings, though many of them might be of superior merit and interest to those printed in full. We notice a memoir, by T. Higgin, F.L.S., on "Fresh-Water Sponges." In it the author criticises the position taken by Prof. Huxley, P.R.S., that "the preservation of the individual and the continuance of the species are the final causes of the organisation" of the fresh-water sponge. This view Mr. Higgin pro-

nounces "the *merest* aassumption, which we are in no position whatever to prove"—or disprove?

The Rev. H. H. Higgins read a note on a collection of *Cirripeda* in the Free Public Museum, and which had been formed by the late Charles Darwin.

Mr. F. P. Mascart read a note on "A Branch in the Pedigree of the Genus *Nassa*, illustrating the Affinities of forty-eight named Forms with *Nassa hirta*."

The Rev. T. P. Kirkman, F.R.S., gave a short—and doubtless singular—reply to Mr. Herbert Spencer's critique on his "Philosophy without Assumptions," so called.

Mr. J. W. Thompson, B.A., read an important memoir on the recent subsidence of land in Northwich.

A communication by one of the corresponding members, Mr. E. D. Jones, C.E., of Sao Paulo, on the mode of feeding of a Brazilian *Mantis*, is very interesting.

Mr. Guthrie read a paper on "Spencer's Physical System as applied to Biology." We insert the Synopsis, all that is here given:—

"Part I. Reply to Mr. Spencer:—General estimate of the effect and value of Mr. Spencer's work.

"Part II. The Primary Facts:—The indestructibility of matter; the continuity of motion; the resistance of force; the ultimate absolute, the final meeting-place of all philophies.

"Part III. The Actual Process examined in order to ascertain the ruling and actual principle of physical change:—The constituents of the nebula—the concomitancy of the concentration of matter and the dissipation of motion disputed; is the universal process limited or unlimited? equilibration the ruling cause of change; equilibrium prevents change; the continuity of motion disputed.

"Part IV. Feeling and Consciousness excluded as Factors in Organisms:—The double-aspect theory.

"Part V. The Biological Explanations:—Organic matter; growth; development; function, waste, and repair; adaptation; the definition of life; the theory of the moving equilibrium; its application to life disputed; genesis unexplainable; on indirect equilibration, not equilibration at all; on the need for the continuation of species; conclusion."

(We have also received the volume for the year 1881-82, but owing to a great pressure of matter we are obliged to defer noticing it until the next month.)

On the Discovery of the Periodic Law, and on Relations among the Atomic Weights. By JOHN A. R. NEWLANDS, F.C.S., &c. London: E. and F. N. Spon.

WE have repeatedly felt it our duty to join in attempts for vindicating the claims of discoverers who have been overlooked. Thus we have persistently asserted the right of Dr. G. Walker to be regarded as the father of Sanitary Reform. In like manner we must now join in recognising Mr. Newlands as the originator of what is now known as the "periodic law." We were unpleasantly surprised, not long ago, when medals were awarded to MM. Mendelejeff and Lothar Meyer, to find that the claims of Mr. Newlands were treated, it would seem, with the "conspiracy of silence." Yet the case lies, it would seem, in a nut-shell. Mr. Newlands's priority is beyond all dispute. As early as 1864 he gave, in the "Chemical News," a list of all the elements then known in the order of their atomic weights, no similar table having ever before been published. In another accompanying table he gave the more important elements arranged horizontally in the order of their atomic weights, with blanks corresponding to some of the missing members of various groups. "In the trivalent group, beginning with boron, there was a blank next below zinc, since filled by gallium, and another blank immediately below cadmium, since filled by indium." In the group containing carbon, silicon, titanium, and tin, it was pointed out that an element of the atomic weight 73 was wanting. This is the very same missing element which M. Mendelejeff subsequently foretold under the provisional name of eka-silicium.

Thus the discovery for which the Russian chemist has been so much applauded—the prediction of an element as yet unseen, with its approximate atomic weight and its place with relation to other elements—was made and published by Mr. Newlands, at least four years before him.

We do not for a moment suppose that Mendelejeff obtained the fundamental idea of his "periodic law" from reading the communications of Mr. Newlands to the "Chemical News." On the other hand, it seems to us a strong confirmation of the value of this arrangement that it should thus have independently suggested itself to two different minds. Yet certainly Mr. Newlands, as the earlier discoverer and revealer, merits no less honour.

To proceed: in the "Chemical News" of August 20th, 1864, Mr. Newlands announced the existence of a simple relation among the elements when arranged in the natural order of their atomic weights, so that the eighth element, reckoning from any given one, was a kind of repetition of the first. Again, in the "Chemical News" for August 18th and 25th of the same year, he published a complete horizontal arrangement of the elements

in the order of their atomic weights. The relation existing between them he named the "law of octaves." This is merely another name for the periodic law of M. Mendelejeff!

Whoever will take the trouble to read this book, and especially to compare it with the author's original communications to the "Chemical News," will, we think, come to the conclusion that the claims of Mr. Newlands are strictly true, and will admit that he must rank as the first discoverer of the Periodic Law.

Geological and Natural-History Survey of Canada. By Alfred R. C. Selwyn, F.R.S., Director. Report of Progress for 1880, 1881, and 1882. Montreal: Dawson Brothers.

This report—or perhaps we may rather say the reader—labours under a serious disadvantage. It is not paged through from beginning to end, but in each of its sections the paging begins afresh.

We learn that in the Museum there are now 3000 species of shells, out of a total exceeding 6000, duly arranged and labelled. A collection of Jurassic fossils, representing 598 species, has also been lately acquired.

The coals and lignites of the Bow and Belly River district have been examined with very satisfactory results. Workable coal-seams occur at several distinct stages, and extend over large areas of country. Some of the beds are of such quality as to be suitable for distant transport, and it is said that the railways of the North-west must depend principally upon this region for their supply of fuel. The deposits of the district completely bridge over the gap commonly supposed to exist between coal and lignite. The lignites are much superior to most of the lignites and brown coal which are successfully utilised in Europe.

There is an interesting report, by J. Macoun, F.L.S., Botanist to the Survey, on the plants collected by Dr. Bell along the Michepoten River and the southern part of the valley of Moose River, in July, August, and September, 1881. The character of this flora resembles that of Central Ontario.

Dr. John Leconte—we regret having to add *the late*—gives a report on the Coleoptera collected in the Lake Superior district and in the North-West territories. It is curious that the little dung-beetle, *Aphodius fimetarius*, so common in Europe, crossed the Atlantic as far back as 1835, and is now extending through the United States and the Dominion.

Among the minerals found is Samarskite, not hitherto met with in Canada, but which has now been discovered just beyond

the north-western limits of the township of Brassard, in Berthier County. The cerium oxides amount to 4·78 per cent.

The report is illustrated with a number of geological diagrams and plates showing the characteristic features of the country, and accompanied with maps showing the basin of the Moose River, the Lake of the Woods, and five districts of New Brunswick.

Papers and Proceedings and Report of the Royal Society of Tasmania, for 1881. Hobart Town: Mercury Office.

THE Proceedings of this Society comprise, among other things, records of meteorological and organic phenomena as observed in different parts of the island.

We see that the jargonelle pear and the More Park apricot are ripe January 12th to 14th, the greengage plum February 18th, and that the leaves of the ash and oak begin to fall in the last week of March. Mention is made of a proposal to introduce "many English birds" into the colony—a project of very questionable utility.

The first snowdrop seen in flower in the Botanical Gardens was on July 9th, and the almond tree blossomed on the 31st of the same month.

Among the papers read before the Society we may mention Notes on the Estuary of the Derwent, by R. M. Johnston, in which it is shown that this locality was during the Tertiary Epoch occupied by a fresh-water lake. This paper includes a description of the general appearance of the country at that date in accordance with palæontological researches.

Mr. C. E. Beddome contributes a description of two new marine shells dredged up near Three Hut Point.

Baron Mueller makes suggestions for an extended elucidation of the plants of Tasmania, and calls particular attention to Mosses, Lichens, Algæ, and Fungi.

Mr. Crouch suggests the improvement of the "Queen's Domain," the Colonial Park.

Another memoir by Baron Mueller describes the Flora of King's Island, situate about half-way between Tasmania and the Australian mainland, and displaying some interesting features.

The Mason College Magazine. Vol. II., No. 1. February, 1884. Birmingham: Cornish Bros.

THIS issue shows no falling off in the quality of its contents. Foremost stands an article on "Schiller as a Philosophic Poet," recalling to our mind strange memories of the past. Will man never be able to unsing the lamentation of the "Gods of Greece," by harmonising the poetic and the scientific Welt-anschanung? Certain ideas lately launched among us make us hope that this may yet be the case.

"Natural Selection and Degeneration" is a most suggestive paper. We read, some little time ago, a medical critique on certain portraits of modern female beauty, but all to the eye of the phy. sician wearing the stamp of scrofula or of phthisis. Much of this, among the middle and the working classes, and the *parvenus*, who are fast elbowing the territorial aristocracy from their seats, is the outcome of our industrial organisation.

In an essay on Swedenborg, the scientific merit commonly ascribed to this mystic is denied. We are naturally sceptical concerning visions which reveal the assumed features of the known planets, but ignore those not yet discovered.

A paper on the relations between plants and animals shows no small ability.

We were not aware that political subjects are discussed at the meetings of the "Union"—not merely questions of what may be called political philosophy, but concerning the details of party warfare. Fortunately we were not compelled to read the debate in question, or we might have fared little better than the unfortunate masters of arts of the Sorbonne, when they encountered the "Borbonesa tart" concocted by Panurge. Might we presume to call the attention of the students to a passage which we quoted in our October issue (1882, p. 625) from the American "Popular Science Monthly"?

The Naturalists' World. Vol. I., Nos. 1, 2, and 3. London: W. Swan Sonnenschein and Co. Manchester: J. Heywood.

THE number of scientific periodicals has strikingly increased during the last few years. We can only hope that the demand is growing in at least an equal proportion; otherwise some of them can flourish—as indeed they seem to do—only by the introduction of irrelevant, if not illegitimate, features.

The little journal before us promises well, and may prove useful in winning over new votaries for Natural History if it is only conducted in a purely scientific spirit. Some of the matter given is exceedingly interesting. We notice especially the experience of Mr. F. W. Halfpenny concerning the virulence of the bite of the common viper. This snake has of late years greatly increased in Epping Forest, and in various parts of Hertfordshire, &c. This increase is, we think, due to the growing rarity of its only efficient enemy, the hedgehog. This useful little animal is hunted down by the gamekeepers on the charge of destroying the eggs of the pheasant and partridge, and often too falls a prey to the Gipsies. In consequence the viper multiplies unchecked. We do not in the least think Mr. Halfpenny's account of his sufferings too strongly coloured. We have personally met with fatal cases of the bite of this species in Hungary, Austria, &c. In Southern France, especially in the Gironde, the deaths among persons bitten are about 20 per cent. A few years ago a young man, whilst on a pedestrian excursion in Surrey, was bitten on the ankle whilst ascending Leith Hill, and died the next day in spite of prompt medical assistance. Whether their bite is more deadly in March and April than in the summer we are not prepared to say with certainty, but they are assuredly more vicious, perhaps because it is their annual season of sexual excitement. Mr. Halfpenny's description of the viper is correct as regards the female, but the ground colour of the male is of a grey, lighter or darker in different localities, and with the same black pattern.

Mr. George Hurst discusses the "Language of Animals." He says, however, little that is of importance, and introduces at the end an error. It is not true that among wild animals the destruction of life is always "accomplished with the least suffering." Bears, wolves, &c., eat their victims by piecemeal, not waiting for life to be extinct. The final remark about "the vile and fallacious excuse of scientific observation" is almost worthy of the *Zoophilist* or the *Police News*.

But for this effusion we could say that we have read the "Naturalists' World" with unmixed pleasure.

Geological Survey of Alabama. Report for the Years 1881 and 1882, embracing an Account of the Agricultural Features of the State. By E. A. Smith, Ph.D., State Geologist. Montgomery: W. D. Brown and Co.

This Report is exceedingly wide and thorough-going in its character, and though drawn up, of course, with especial reference

to the geological features and general local circumstances of the State of Alabama, it may be profitably studied by all interested in the future of Agriculture in any part of the world.

The author has prepared himself for his task by a careful study both of the natural phenomena of the district and of all the more important works in which agricultural chemistry is expounded. He begins with a general discussion of the composition, mode of formation, and properties of soils, and of the changes produced by cultivation. After treating very fully and carefully of the soil in its chemical and geological relations, of the conversion of rock into soil, and of the mechanical action of water and other denuding agencies in removing the waste produced by weathering, he goes on to consider the soil in its relations to vegetation. Among the organic agencies concerned in the production of soils the action of earth-worms is not forgotten. The views of Darwin have, it appears, been confirmed by practical men in Alabama, as elsewhere. We are told that "it has not escaped the observation of many farmers in this State that when a mass of sand has been washed down over a fertile bottom, it will, in a few years, again be covered by a layer of vegetable mould which earth-worms have, in the manner indicated, brought up from below and spread over it."

Passing on to the soil in its relations to animal life, Dr. Smith gives emphatic prominence to certain considerations too generally neglected. He shows that wherever plants alone are concerned there is a full restitution of plant-food to the soil. Its fertility, indeed, is not merely maintained, but enhanced, "since by the constant action of the weather, aided by the acids, &c., produced by the decay of one generation of plants, the inert constituents of the soil are gradually turned into an available form, and thus placed at the service of another generation."

Animals, however, disturb this equilibrium to some extent, and by the intervention of man the natural provisions for maintaining the fertility of the soil are further compromised. Not merely is a portion of vegetable matter removed year by year in the form of the crops, but by the destruction of the forests "the inequalities of the rainfall are very much exaggerated, heavy rains alternate with protracted drought; the soil, deprived of its protecting coat of vegetation, is exposed to all the destructive action of the rains, by which it is loosened and in a great measure carried away to be deposited again in the valleys; and the hill-sides, as well as the gentle slopes, are disfigured and often rendered unfit for cultivation by the cutting of gullies and ravines. With loose, loamy soils, such as characterise the greater part of the State of Alabama, the destruction of lands from this cause probably far exceeds their exhaustion by the improvident systems of culture usually followed."

We may add that this process of denudation, by which the soils are carried away into the valleys, and even into the river-

beds and sea, is in many districts accelerated by the "action of burrowing animals." We have often noticed that in slopes infested by rabbits, their holes seem to give the rain a special point of attack.

The following remark is true and sad :—"To the traveller through the Southern States, the pictures presented so often around the older villages and towns, of red clay hills, gashed and scored by unsightly gullies, are all too familiar."

The very same process has been carried on for a much longer time in all the countries of the Mediterranean Basin. It has been taken up in Central Europe, and in all European Colonies —British, French, Spanish, or Dutch. In short, desolation follows wherever the forests have been generally removed, whether by war, by the action of goats and camels, by fires, or by human greed. An American observer has wisely remarked, not long ago, that if one-fourth of a country is allowed to remain covered with trees and bushes, the remaining three-fourths will yield more food for man than would the whole if denuded.

As regards the exhaustion of soils, the author quotes from Mayer a very instructive remark explanatory of the fact that phosphoric acid must be present in the soil in much larger quantities than is actually needed for the present crop. The phosphates in the soil are insoluble, and must have come into direct contact with the capillary fibres of the roots before they can be assimilated. But as only a limited number of such particles can come into actual contact with the roots, only a small proportion of the phosphate present can be assimilated during one season.

Dr. Smith gives particular prominence to potash, nitrogen, and phosphoric acid as the three elements of plant-food most likely to be exhausted. As regards lime, to which M. Ville assigns an almost equal rank, our author holds that when added it serves not so much as plant-food as to produce changes in the other ingredients of the soil which render them more easy of assimilation.

The author's explanation of the manurial effects of gypsum is that it replaces the bases, especially potash, absorbed by the plants. He notices also the surmise of Heiden, that by a concentration of the soil-fluids it diminishes the transpiration of moisture through the leaves of plants, so that a dressing with gypsum may enable a crop better to resist the action of drought. He admits, however, that no theory as yet put forward fully explains the beneficial action of gypsum on leguminous plants and its uselessness for cereals.

We regret that we cannot further pursue our examination of this work, which must be recognised as possessing no mere ordinary degree of merit.

Journal and Proceedings of the Royal Society of New South Wales, 1882. Vol. XVI. Edited by J. A. Liversidge, F.R.S., Professor of Chemistry and Mineralogy in the University of Sydney. Sydney: Richards. London: Trübner and Co.

This number, though somewhat late in making its appearance, contains much important matter.

The President of the Society, H. C. Russell, F.R.A.S., the Government Astronomer, in his Anniversary Address, discusses the notion of producing rain artificially. This question does not excite much attention in England, since in nine seasons out of ten we have too much rain,—if not for the entire year, yet just in the months when every drop is a nuisance. But in South Africa and Australia the power of causing rain to fall at will would redeem vast tracts of country from barrenness, and save thousands of persons from severe losses. Mr. Russell has, therefore, carefully collected evidence on the possibility of rain-making. A vague notion prevails in several countries that fires, explosions, great battles, &c., are often followed by rain. Curiously enough some observers ascribe to the discharge of cannon the very opposite effect—the dissipation of storms! Mr. Russell does not seem disposed to deny that when the atmosphere is in the condition called unstable equilibrium, when a cold current overlies a warm one, violent concussions and columns of hot gases ascending, might determine rain; but in the dry years in Australia the equilibrium of the atmosphere is exceptionally stable.

Mr. Liversidge contributes a paper on the Deniliquin meteorite of 1872. This stone is of the great weight of 145 lbs., and belongs to the class of siderolites—mixtures of silicates with metallic nickeliferous iron. Copper, chrome, cobalt, manganese, and aluminium are present, but tin is absent.

The Bingera meteorite, described in the next paper, contains the same metals with the addition of tin, but apparently no manganese. It is interesting to note that these meteorites have been examined spectroscopically. The question has been raised whether such examination might not possibly lead to the discovery of certain of the rarer metals, or even of elements not yet recognised in our earth. The result, however, in these cases must be pronounced negative. Prof. Liversidge is still engaged with an examination of the Bingera meteorite, with especial reference to occluded gases.

Mr. Liversidge makes further communications on the chemical composition of certain rocks from New South Wales, New Britain, and New Ireland.

The Rev. J. E. Tenison-Woods describes at some length the Hawkesbury sandstone formation. He finds no evidence of glaciation, but notices traces of volcanic outbursts on a gigantic

scale. The flora buried beneath the volcanic ash appears totally different from that of modern Australia.

Mr. Russell communicates a paper on "Tropical Rains," illustrated with six maps. The heaviest rain on record in the Colony was in 1860, when downfall began at 4 p.m., and by 3 a.m. the Shoalhaven River had risen 100 feet!

The Rev. J. E. Tenison-Woods describes some mesozoïc fossils from the Palmer River, Queensland.

Mr. James Manning, in "Notes on the Aborigines," maintains that the blacks have a general belief in a Deity, all knowledge of whom is carefully concealed from the women and children.

The Aborigines form the further subject of discussion in a paper by J. Fraser, B.A.

We regret that Zoology in all its branches seems to be entirely overlooked by the Royal Society,—a fact the more serious in a country where so much work remains to be done.

Experimental Chemistry for Junior Students. By J. Emerson Reynolds, M.D., F.R.S., V.-P.C.S., Professor of Chemistry in the University of Dublin. Part III. Metals and Allied Bodies; with an Analytical Appendix. London: Longmans and Co.

Rarely do we open an elementary treatise on Chemistry without regret. The present volume forms, we are happy to say, one of the rare exceptions. It contains not a word of reference to any examination. No "syllabus,"—or "syllabub" as we heard it called by a rustic sage,—whether new or old, is here held up as the object to be held in remembrance by the learner. Dr. Reynolds rationally seeks "to place the student to some extent in the position of an independent investigator of chemical phenomena." He is to be led "to recognise the natural affinities of the elements, as well as their distinctive characters." Such an exception from the ordinary run of manuals, which aim rather at qualifying the student to pass some examination than to give him a living and fruitful insight into the science, is truly refreshing. Let us hope that it is an omen of better things for the future,—of a reaction against that miserable examinationism which earns for us the title of the "Chinese of Europe."

Our Corner. A Monthly Magazine of Fiction, Poetry, Politics, Science, Art, Literature. Vol. III., No. 3, March 1st, 1884.

THIS Journal, though of heterodox repute, shows no lack of ability. With its literature, and above all its politics, we can have no concern. But we find here two scientific articles of undeniable merit; to wit, the "Microscopic Examination of Rocks," by W. Mawer, and "Insects and Flowers," by Dr. E. B. Aveling. The latter writer seems to us to impart here a larger amount of sound scientific truth than is generally offered by a certain showy and admired author who treats largely on kindred subjects. Perhaps Dr. Aveling is thinking more of his subject and less of himself than do some of his contemporaries. We are particularly gratified at finding prominent notice given to the fact—often overlooked—that between the entomophilous and the anemophilous plants there is no rigid line of demarcation. We can strongly recommend this essay to students, of whatever age.

In passing we may notice the biography of Bruno, which is introduced at the end of the number. In it the outlines of his life are filled in without being distorted. It is strange to us that no one has yet selected the hero-sage of Nola as the subject of a philosophical novel.

To show the undiscriminating manner in which some publishers send out books for review, we mention that we have received from Mr. J. Morris of Chicago, a treatise entitled "Mr. H. Irving and Miss Ellen Terry in America"!—a matter as much outside our cognizance as are, *e.g.*, the proceedings of the Salvation Army.

CORRESPONDENCE.

*** The Editor does not hold himself responsible for statements of facts or opinions expressed in Correspondence, or in Articles bearing the signature of their respective authors.

HYLO-IDEALISM.

PERMIT me to thank you for your admirable review of Captain McTaggart's very ingenious "Examination of Hylo-Idealism," and at the same time to offer a few remarks which may tend further to clarify the subject. The last sentence which you quote may possibly becloud, for uninitiated readers, the strictly Monistic character of the thesis maintained by Dr. Lewins. Captain McTaggart states that "Matter is affected by spirit (force), spirit by matter." This seems at first sight to re-admit Dualism; but from other passages we gather that the mysterious "Spirit" is merely the noumenon or proplasm of physical and psychical phenomena. Now it is surely far simpler and better to speak of this proplasm as "Matter," and thus to avoid the very equivocal term "Spirit," which is irrevocably committed to Dualistic associations, and really is itself material, as it means nothing but "breath" or "wind." The word "Matter," on the other hand, being identical with "mater," the mother or producer, is especially applicable to the *fons et origo* of the phenomenal world.

The sentence "What is matter, or what is spirit, we cannot know, and what their point of contact is we may not even imagine," when taken in conjunction with the statement that spirit is "an unknown x underlying force and matter," can scarcely fail to suggest reminiscences of the Athanasian Creed, with its "three incomprehensibles," which yet, in the end, are not Three, but *One* incomprehensible.

C. A.

THE DETECTION OF BACTERIA AND THE SEWAGE QUESTION.

IT might have saved Dr. P. Frankland some trouble if, in his alarmist paper read before the Society of Arts on the 13th ult., he had remembered that bacteria, &c., are precipitated from

water by the addition of a few drops of a solution of aluminium sulphate. On straining off and re-dissolving the precipitate the bacteria are found. The success of this process, known as Brautlecht's method, shows that disease-germs need not be feared in the effluent water of sewage which has been treated with sulphate of alumina. Had this fact, and the action of alum in rendering foul waters harmless,—well known in China, Cochin China, &c.,—been considered, the public might have been spared the *rechauffée* of the Report of the Rivers' Pollution Commissioners to which they were treated by Dr. Frankland.

ARGUS.

ERRATUM.—March No , heading of article on "Vaccination," *for* GILEBS *read* GIBBS.

NOTES.

ACCORDING to the "Courrier International" there exists at Sonora a pyramid measuring at its base 4350 feet, and rising to the height of 7550 (? 755) feet. Hence its size is about double that of Cheops.

Mr. Harold Whiting ("Science-Bulletin") proposes the following law connecting the physical constants:—"The product of the latent heat, molecular weight, and coefficient of expansion $=8 \cdot 4$ for liquids at 0° C. expanding by ordinary law. The product of the mechanical equivalent of the latent heat and the density is $1 \cdot 2$ times the product of the coefficient of expansion and resilience, and the absolute temperature."

It appears that the so-called "National Park" of the United States requires attention to guard it against the attacks of speculators.

From a recent decision it appears to be perfectly legal to pollute and poison underground waters, springs, &c., by running into them sewage, &c.

It appears that in the years 1831 and 1876-77 atmospheric phenomena, very similar to those observed in November and December last, were noticed and recorded.

On January 14th a sudden retreat of the sea, followed by three waves which raised it for a short time to 1·5 metre above its ordinary level, occurred at Monte Video.

According to M. G. Calmels the poisonous secretion of the toad contains a small quantity of methyl carbylamine and of isocyanacetic acid, to which it owes its poisonous properties. A similar acid exists in the poison of *Triton cristatus*, *Salamandra maculata*, and of the scorpion.

We regret to hear that the Dublin Zoological Society is in danger of coming to an end from lack of funds. The case seems the more hopeless as unworthy means of increasing the Society's income have already been resorted to. The returns of a dog-show (!) held last year in the Society's garden were £153.

M. P. Gibier ("Comptes Rendus") finds that rabies can be communicated to birds, which, however, recover spontaneously. Mammals inoculated from such birds die with the ordinary symptoms of rabies. M. Pasteur questions the immunity of birds.

MM. Moncorvo and Silva Araujo have succeeded in curing elephantiasis by the application of electricity.

Dr. J. Foster, in a paper read before the Sheffield Medico-Chirurgical Society, advances the questionable opinion that "some of the greatest literary productions have been the work of men between 50 and 70. Living public men in every department of literature, science, and art may be cited as proof."

Mr. G. Dimmock ("Science") has found a redeeming feature in the character of the common earwig. It is an eager devourer of fleas, and may therefore claim toleration in bed-rooms, though not in gardens.

At the coming Montreal Meeting of the British Association the following subjects are selected for special discussion in Section A (Mathematical and Physical Science):—

1. On Friday, August 29.—The seat of the electromotive forces in the voltaic cells.
2. On Monday, September 1.—The connexion of sun-spots with terrestrial phenomena.

The names of those who propose to read papers, or are willing to take part in the oral discussions, should be sent not later than June 1, 1884, to *The Secretaries of Section A, British Association, 22, Albemarle Street, London, W.* No paper should in reading occupy more than fifteen minutes, and no speech more than ten minutes.

During a recent technical trial a learned judge observed that he had a great respect for professional witnesses, but none for *witnesses by profession.*

An international ornithological conference is to take place, on the 16th of this month, at Vienna.

A biological institute is about to be organised at Philadelphia.

At a recent meeting of the Entomological Society a paper was read on the decrease of butterflies in the district of Huddersfield during the last twenty years. Several gentlemen referred to a similar decrease in other parts of England, common species having become scarce, and scarce ones disappearing entirely.

According to M. E. Juny violet light is favourable to the development of the eggs of various animals, whilst green and red lights seem to have an injurious, or at least a retarding, influence.

It is a characteristic tendency of the anti-scientific mind to refer physical phenomena to moral causes. See Mr. Ruskin's remarks in "Fors Clavigera" on recent cloudy seasons.

M. G. Karsten remarks that after the great eruption of Skapter Jokul, in Iceland, in the spring of 1783, atmospheric phenomena similar to those of the past winter were observed in Europe, northern Africa, and eastern Asia.

"Les Mondes" informs us that aluminium has been found an excellent remedy against phthisis. (But not, surely, in the metallic state?)

An attempt is being made to introduce the turtle in the seas of Provence, Algeria, and Corsica. Plots are being arranged where these creatures may deposit their eggs in safety.

According to Mr. W. H. Harrington ("Science") the Coleopterous fauna of the neighbourhood of Ottawa, Canada, includes 1050 species. It is poor in Carabidæ and Dytiscidæ, but relatively rich in Buprestidæ, Elateridæ, and Cerambycidæ.

During the last three years the cases of hydrophobia in the Department of the Seine have been respectively 17, 11, and 6.

According to "Les Mondes," in the districts of the Opera and the Madeleine, the Edison Company are distributing electricity from house to house, and supplying the inhabitants with power and light almost gratis. The writer adds "Mon Dieu! que l'espérance est une belle chose!"

A company is being formed in America for constructing a ship-railway across the isthmus at Tehuantepec.

Says M. Valette—"Everyone knows that at the Academy the power to bind and to loose is vested in the Perpetual Secretary alone."

From an official report, quoted in the "Pall Mall Gazette," we learn that of the 81,000 masters and mistresses in the public schools of France, 48,000 receive salaries below £40 yearly!

We remark that the National Museum of the United States, though provided with distinct Curators for the Departments of Conchology, Ornithology, Ichthyology, Herpetology, for Marine Invertebrates, and for Mammalia, has none for Entomology.

It appears that the antiseptic properties of carbonic acid were observed and recorded by a Dr. Macbride prior to Hermbstädt. Macbride's experiments are mentioned in the "Essai sur differentes Especes d'Air," by Sigaud de la Fond, published in Paris, in 1769. Hermbstädt's work did not appear until 1791.

M. Pasteur ("Comptes Rendus") announces that the less of the virus of rabies is introduced into any animal, the longer is the stage of incubation, and the more furious is the type of disease which follows. But if dilution is carried beyond a certain limit the inoculation takes no effect.

Mr. Hugh Browne points out that the Sutlej descends 12,000 feet in 180 miles, or at the rate of 666 feet per mile, being probably the swiftest great river in the world.

At the Annual Meeting of the Royal Society of New South Wales, in 1883, papers were read on the Geology of the Hawkesbury Sandstone, by Rev. J. E. Tenison-Woods; on Tropical Rains, by H. C. Russell, F.R.A.S.; on the Orbit of the late Comet, by G. Butterfield; on a Method of determining the True South, by J. S. Chaud; on the Progress of New South Wales, by Chr. Rolleston; on Marine Fossils of the Coal Formation of New South Wales, by Rev. J. E. Tenison-Woods; on Mesozoic Fossils from the Palmer River, by J. C. Tenison-Woods; on French Geographical Societies, by E. M. de la Mesler; on Aborigines of Australia, by James Manning; on the Ashes of some Epiphtic Ferns, by W. A. Dixon; and on a Fossil Plant Formation, in Central Queensland, by Rev. J. E. Tenison-Woods. M. Louis Pasteur was elected an Honorary Member, *vice* Charles Darwin, deceased; and Dr. Ottocar Feistmantel a Corresponding Member.

M. Zenger has constructed a direct-vision spectroscope for the observation of the ultra-violet rays. It consists of a new combination of prisms of quartz and calcareous spar.

It is said that during the tempest of January 26th telegraphic communication between Paris and the provinces would have been substantially cut off had it not been for the underground wires.

During the earlier part of 1883 the atmosphere at Reunion was so pure that the planet Venus could easily be distinguished with the naked eye during the whole of the day.

M. G. Le Grant de Tromelin ascribes the production of atmospheric electricity, in a great measure, to the friction of the air against the surface of the land and of the sea.

A writer in "Cosmos les Mondes" remarks that Sirius, which to us appears of a brilliant white, is described by Horace as *rubeus* and by Cicero as *rutilus*.

According to the "Medical Press and Circular" the University of Oxford, by a decree of Convocation passed on the 4th ult., has decided to engage a table at the Zoological Station of Villefranche, for the use of students of the University. The Bestiarians made a counter demonstration, but did not venture to go to a division. (It is instructive to compare the watchfulness and energy of the Bestiarians with the "masterly inactivity" of the Society for the Promotion of Medicine by Research.)

It is understood that a Bill for the incorporation of the Institute of Chemistry is to be introduced into Parliament during this

Session. Without great care this will be made an occasion for increasing the power and influence of the Science and Art Department.

According to P. Shiemeny (" American Naturalist ") the supposed olfactory mucous gland in insects secretes saliva.

With a view to the complete study of the migration of birds in the Nearctic Region the whole of the United States and British North America have been mapped out into thirteen districts, in each of which is a Superintendent whose duty it is to collect information from observers and transmit it to Mr. C. Hart Merriam, Chairman of Committee on Migration, Locust Grove, Lewis County, New York. Birds are classed in five categories, —permanent residents, winter visitants, transient (spring and autumn) visitants, summer residents, and stragglers. Ornithological movements are to be noted in connection with meteorological phenomena and with the changes in the vegetable world.

According to T. R. Peale (" American Naturalist ") the inhabitants of Fanna Loa eat their food raw, and appeared terrified at fire, even on so small a scale as a lighted cigar. No traces of charcoal, ashes, or other signs of cooking, were found near their houses. Hence the command over fire and the use of cooked food can no longer be put forward as general characteristics distinguishing man from the lower animals.

We have to express our pleasure at learning that Prof. Bryce is about to introduce a Bill into Parliament for throwing open the mountains, moors, &c., of the Highlands, to geologists, botanists, entomologists, artists, &c., on the simple condition that they shall not be accompanied by dogs, and shall do no damage. This Bill deserves the warmest support of all lovers of Nature.

Dr. F. V. Hayden (" Science ") warns all whom it may concern against a swindler who introduces himself to scientific men as a colleague, professes to be preparing memoirs on some special subjects, and steals books and specimens, or, if this is impracticable, borrows them and never returns them. He has robbed several museums, libraries, &c. Should he visit Europe we recommend our friends to be on their guard.

According to Prof. A. Graham Bell congenital deafness and epilepsy, instead of being rarer, are more common among the Negro and Negroid population of the United States than among the Aryans.

Dulau 7
2.4.84.

TWENTY-FIRST YEAR OF PUBLICATION.

THE

JOURNAL OF SCIENCE,

AND ANNALS OF

ASTRONOMY, BIOLOGY, GEOLOGY, INDUSTRIAL ARTS, MANUFACTURES, AND TECHNOLOGY.

(MONTHLY, FORMERLY "THE QUARTERLY JOURNAL OF SCIENCE.")

Vol. VI. (Third Series)
No. CXXV.

MAY
1884.

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LONDON:
3, HORSESHOE COURT, LUDGATE HILL,

Where Communications for the Editor and Books for Review may be addressed.

THE

JOURNAL OF SCIENCE.

MAY, 1884.

I. STELLAR PHOTOGRAPHY.

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THE great and rapid improvement in the sensitiveness of dry plates for photography has at length allowed of successful photographs being taken of some celestial objects. At the Oxford Observatory for some time the moon was photographed with a 13-inch reflector on every available night, and the photographs have been so perfectly taken that they allow of measurement under high microscopical power. The possibility of photographing the moon has, however, long been known. But with the other heavenly bodies the matter is a somewhat difficult one. The image formed at the focus of the telescope is so extremely small, and the difficulty of following the celestial object—whatever it may be—so great, that the results hitherto obtained are not more curious than of scientific value. M. Common, with a reflector of 37 inches aperture, has however succeeded in photographing the planets Saturn and Jupiter. With a powerful magnifying-glass it is possible to see the ring of the former, and the photographs that have been obtained of the latter show some detail on enlargement. The red spot which has been the chief object of interest so long was visible on one photograph. The difficulty of photographing any detail on this planet will be the possibility of extremely short exposure; for the rapid rotation of the planet on its axis, *viz.*,

about ten hours, quickly causes a displacement of the details visible at the time of observation.

With Saturn the image is so small that we cannot hope at present for much information from the photographs obtained of them.

The curious objects scattered up and down the heavens, and called nebulæ, form a much more likely class. The difficulty of drawing these objects is very great. Different observers are struck with different detail, and the keener-sighted observer will give an entirely different form to some wisp or patch which is figured by both. Hence the various drawings of the great nebula in Orion seem to show the light grasping powers of the instruments used, and the keenness of the observer, rather than an actual change in the nebula itself. If, then, the nebula could be photographed from time to time, there would be a means at once of determining whether any change had taken place. This has actually been done by Dr. Draper in America, and by M. Common in England, both using large reflectors. M. Common's photograph, being taken with the largest aperture, shows of course the greatest amount of detail, but the glare from the brighter stars destroys the photograph of the parts of the nebula near them.

But besides this field there is yet another where valuable work may be done. The photographic plate is most sensitive in the violet part of the spectrum, and least sensitive in the red. Hence the image impressed upon the plate will be the result of the violet light emitted or reflected from that object. Supposing two flames, one of red and the other of violet colour, were photographed on the same plate with the same exposure, although in intensity to the eye the red might be far the brightest, yet, since the plate is most sensitive to the violet, the brightness of the images on the plate would be reversed, the violet one coming out many times brighter than the red one. Now the stars are of various colours, some white, others blue, some red. If, then, the stars were photographed, the intensity of the image on the plate—just as in the case of the two flames—would be greatest for those stars which emitted most violet light. In this way it would be possible to obtain an accurate record of the violet light in the stars.

Again, the violet light is chemical light. All life, animal and vegetable, depends upon this chemical light. If less than a certain amount, all life would cease in all probability; while, on the other hand, if greater, its very intensity would kill plants and animals, or else produce a very exaggerated

state of life. The late Sir W. Siemens made some experiments on the action of the electric light, which contains a very large percentage of chemical light. He found that when plants were exposed to its light they grew at a great rate. Fruits could thus be forced at any season of the year. But he also found that if the light was left bare it quickly, by its chemical intensity, killed the plants. To prevent this the light was placed in a glass globe, glass being a great absorbing medium of the chemical rays of light.

Various attempts have been made to photograph the stars. Prof. Pickering, in America, has photographed the Northern Heavens, to make a map and determine the magnitudes. The writer of the present paper has endeavoured to go a step further, and tried to determine relatively the chemical light in the stars by means of photography. Using a lens over 2 inches in aperture, various plates were taken of the most prominent stars with very interesting results. Alpha Lyræ, which is a very white star, left an impression on the plate with only five minutes' exposure. Alpha Cygni, a star of the same colour, impressed itself with equal rapidity. With long exposures, of one hour and a half, as many as 120 stars were photographed on a plate of greater size. On one plate over forty stars were photographed in the Pleiades, a cluster the stars of which seem to possess a large amount of chemical light. The red or orange stars, as was to be expected, came out comparatively faint on the plate. In the case of α Cete, a star consisting of a second magnitude orange star and a $6\frac{1}{2}$ mag. blue, a result was found confirming Prof. Pickering, *viz.*, that the blue star came out the brighter of the two. In some cases, however, where there is little or no difference in colour to the eye, the impression on the plate in no way corresponds to the star's magnitude. Hence a new line of research is opened up—a research into the actinic light of the stars. Using the ordinary magnitude scale as the basis, it is possible to deduce magnitudes from the photographic plate and compare them with the eye magnitude. Obviously all the stars photographed will fall into one of three classes; they will be equal in magnitude to the star's magnitude as determined by the eye, or they will be above it, or else below it. Hence we have a new method of determining accurately the star magnitudes, on the one hand, and on the other of cataloguing stars whose chemical light is either greater or less than the light that affects the eye. The star magnitudes can be determined from the photographic plate with the greatest accuracy, and with one great advantage—that the photograph can be taken

and the plate developed and put away, and be available at any time for the determination of the star magnitudes. Besides this it is a valuable thing to have a record which is practically free from errors of the stars visible at a given time in a given part of the heavens.

The Liverpool Astronomical Society has lately, through the munificence of Mr. Howard Crabb, been able to set up apparatus for carrying on the work of Stellar Photography. This is an Equatorial Stellar Camera, driven by clock-motion, and fitted with a compound lens $4\frac{1}{2}$ inches in aperture. Already some fifteen hundred or more stars have been photographed. The number of stars on any one plate depends on two conditions—the sensitiveness of the plate and the length of exposure. The great clusters in Gemini and Cancer, and the spiral nebula in Canes Venatici, have already been photographed, as well as several double and variable stars. Doubtless as the work progresses many interesting results will be obtained in so new a line of research.

II. INCIDENTS OF THE EARLY LIFE OF FRIEDRICH WÖHLER.

(BORN JULY 31ST, 1800; DIED SEPTEMBER 23RD, 1882.)

By Miss KATHERINE WINDSCHEID.

FRIEDRICH WÖHLER was the descendant of a family in comfortable circumstances, living in Central Germany. His grandfather was Master of the Horse to the Landgrave William IX. of Hessia; his son, August Anton, Wöhler's father (born January 28th, 1771), studied the veterinary art and rural economy, according to the wishes of his family, though without any special inclination. Far, however, from preparing himself exclusively for this vocation, he had profited so well by a sojourn of several years at the University of Marburg, studying the different branches of philosophical and philological science, that on

leaving the university he not only possessed vast learning, but the compass of his understanding went far beyond his professional sphere. Almost immediately after the conclusion of his academical studies the young man was named, by the Landgrave of Hessia, Master of the Horse to his son and heir, who resided at Hanau. Their relations, however, were destined to end in a peculiar manner, as will be told further on. Anton Wöhler now entered, in the same capacity, the service of the Duke of Meiningen, at whose Court he soon gained an influential position by the numerous reforms which he introduced in rural economy.

Court life, however, seems not to have agreed with his love for independence. In the year 1806 we find him the happy possessor of an estate in the neighbourhood of Frankfort-on-the-Main. But a few years later the brilliant results of his farming method had attracted the attention of wider circles, and Wöhler was induced by the "Fürst Primas Dalberg" to settle down as Master of the Horse at the Grand-Ducal Court. Here this excellent man entered upon the right field of action, and henceforth devoted himself with extreme success to the furtherance of what was good and beautiful. There existed no society, working either for the intellectual or the moral welfare of the citizens, in which he did not eagerly participate. The Wöhler School, founded twenty years after his death, and greatly prospering at the present moment, is the best proof that his work is held in grateful remembrance by a later generation.

An interest similar to that evoked by the contemplation of this rich life is due to his wife, though as regards her we do not possess such extensive information. She was the daughter of the Head-master of the College at Hanau,—a tall, stately lady, who enjoyed up to her latest days the most perfect health. Those who knew her describe her as a clever woman, endowed with inexhaustible good humour, and with a gift of looking at life in a gay and highly original manner,—a woman who was never at a loss for a proper word at the right moment.

This short glimpse of the home of Wöhler's parents is all the more certain to excite our sympathy as it shows us the favourable circumstances which attended his development.

Friedrich Wöhler was born on the 31st of July, at Eschersheim, in the house of his mother's brother-in-law, who was then the clergyman of the village. The reason why his mother was not at home on the eve of so momentous an event deserves to be recorded, as it characterises the state of affairs in Germany at that period. Her husband was

then, as has been said, Master of the Horse to the "Kurprinz" of Hessia, a potentate not represented by history in a flattering light. His impetuous and violently passionate temper knew no bounds. As he visited his stables one day in the company of his Master of the Horse, some trifling circumstance excited his anger to such a degree that he insulted him in the most unbearable manner, and finally proceeded to acts of violence. This was too much even for our good Wöhler; he seized a riding-whip, and gave his Highness such a correction as probably he had often deserved, yet never received. A good horse soon removed the avenger out of the immediate jurisdiction of the chastised potentate, and the Prince, justly fearing to appear ridiculous, had sense enough not to prosecute the fugitive. Wöhler's family, however, was obliged to leave the town in a hurry, and his wife was most happy to find refuge in the house of her brother-in-law.

When the boy had attained his seventh year, his father himself taught him the rudiments of reading, writing, and drawing. He then was sent to a public school, and afterwards took private lessons in Latin, French, and music.

In the year 1814 Wöhler entered the Gymnasium at Frankfort, where he pursued his studies up to the time he left for the University. He regularly went to school, and was promoted to the higher classes after the usual time, yet did not distinguish himself, as he afterwards candidly acknowledged, either by zeal or by learning; the reason being that he was constantly engaged in chemical experiments, as well as in the gathering of minerals, and thus his tasks were often neglected. To this early awakened passion he was indebted for the honour of being presented to Goethe, whom he met in the shop of a dealer in minerals.

Dr. Buch, a man of high culture, a physician by profession, had great influence on Wöhler's scientific career. It was from him that he received the first impulse for serious physical studies. He published in 1821 a little essay, at the head of which Wöhler's name appears for the first time in literature. The use of Dr. Buch's well-assorted library better enabled him to fathom the secrets of chemical processes, and soon experimental research became with him an all-absorbing passion. There were other things besides that interested the boy. He had regular lessons in drawing, made sketches from Nature, and even tried his hand at oil-painting. Under the direction of a young painter, with whom he took lessons, he began to study more closely the poetical literature of his country, which then had already obtained a high degree of perfection.

When Wöhler was a boy Germany languished under the unbearable yoke of the French invaders. He was too young fully to feel the heaviness of the oppression, too young to share the glorious impulse which aided in liberating Europe from the hated tyrant, yet he preserved in later years a vivid recollection of the great events of that time.

Meanwhile our young friend had, from a feeble and even sickly boy, grown to be a strong bright youth. He himself attributes this happy transformation to the extreme care which his parents took of his physical development, and to their sensible way of strengthening his constitution.

In the spring of 1820, when nearly twenty years old, Wöhler went to the University. A family council had determined that he should study medicine, partly because favourable circumstances seemed to assure him a prosperous future in this line, partly because his own inclination pointed in that way. The first year he spent at Marburg, where his father had studied before him, and where several old friends of his family still lived, who had been requested to guide the inexperienced youth. He attended lectures on Botany, on Physics and Mathematics, as well as on Anatomy, and at the expiration of the year exchanged Marburg for Heidelberg. His mind was filled beforehand with enthusiasm for Prof. Gmelin, who then lectured on Chemistry at that town, and who throughout his College life remained his true friend and benevolent adviser. He ardently wished to attend his readings: Gmelin, however (in Wöhler's case), considered it a waste of time, and thus it came to pass that he, of all men, never heard lectures on Chemistry. He greatly profited, however, by the opportunity of working in his laboratory. Nearly all the time he could spare from his medical studies he devoted to Chemistry. He began the experiments on cyanogen, the results of which he deposited in two essays, published in 1821 and 1822. In their author we already recognise the accomplished man of Science.

Wöhler still intended to become a practising physician, his inclination for this vocation strengthening as he gained more precise knowledge of the practical side of medical science. In September, 1823, Wöhler and a friend of his took their degree as M.D. It had been decided that Wöhler should now go abroad, in order to visit larger hospitals. Another direction, however, was given to his life by Prof. Gmelin, who advised him to abandon the medical science, and to devote himself wholly to Chemistry, a proposal to which Wöhler immediately consented. Stimulated by Gmelin, and encouraged by the friendly manner in which his

first essays had been criticised by Berzelius, he applied to the latter for permission to work in his laboratory. Berzelius replied in the most benevolent terms, and this first letter opens the long and most interesting correspondence which united Wöhler and Berzelius up to the time of the death of the latter.

III. THE GHOST OF THE SEASON.

By "Argus."

RE-APPEARANCES and even re-incarnations of the dead, I am told, have undergone a marked revival. They are no longer laughed at as dreams or impostures of by-gone days, but meet with respectful attention from men of learning and repute. This change in public temper may, perhaps, help to account for a fact lately witnessed, above all places, in the rooms of the Society of Arts. There and then was manifested the ghost, not of defunct man or woman, but of a three-headed being which during its lifetime had "neither a soul to be lost nor hinder-quarters to be kicked," and which is generally thought to have made ample use of this privilege. In other words, the shade or "shell" of the late Royal Rivers' Pollution Commission has possessed or "obsessed" a living man, and compelled him to reproduce once more its notions and its recommendations.

Of this Commission I have no wish to speak harshly or imputatively. It possessed ample scientific attainments, but was not burdened with practical common sense. It had, from the very outset, strong prepossessions, and it appears mainly to have sought evidence for their confirmation. It told us little that was new, and suggested, perhaps, still less that was feasible. But had it not been for this ill-timed and injudicious re-appearance the world would have been quite willing to forget its shortcomings, and not to inquire too closely as to the benefit derived by the nation in return for a heavy outlay of public money.

Yet, like many other and doubtless abler men, I feel bound to re-examine the views which were once more thrust upon us on March 13th.

I will first take in hand one of the fundamental dogmas of the Commission. This may be fairly embodied in the following words :—" If a river be once polluted by sewage matter, the water of that river was for ever unfit for dietetic purposes, and no practical distance of flow would render such a river safe." This dogma is professedly based upon the experiments of Prof. Frankland. He has made analyses of water taken from different portions of a polluted river, and has told us that as it flows its proportion of pollution—*i.e.*, of organic impurities—remains substantially the same. He has also, after determining the impurities in a sample of sewage, mixed similar sewage with water and shaken it up with air in a bottle, in order to ascertain if the impurities were to any extent destroyed by oxidation! It is difficult to imagine how any man accustomed to scientific research, and acting in good faith, could persuade himself or try to persuade others that this experiment in the least degree reproduced the conditions found in a river. In a river there is doubtless, as in the bottle, contact with air and exposure to light: but in the river there are agencies which were absent in the bottle. There are animals of low grade which devour the filth; there are vegetables—all water-plants—which, whenever the sun shines, and even under the influence of diffused daylight, give off oxygen, and oxidise, or in common language burn up, the impurities. Both these agencies, I repeat, were wanting in Prof. Frankland's bottle, whilst they are present more or less in every river. In the Thames above London they are certainly not wanting.

But leaving this bottle experiment, as a something childishly inadequate, let us look to observations made on the large scale. It is well known that the River Oder, the main water-course of Prussian Silesia, passes through the city of Breslau, and receives all the household sewage and industrial waste waters of that large city. Dr. F. Hulwa has recently made a very careful examination of the water of the river. He finds naturally a progressive deterioration as it flows through the city, reaching its maximum at a point where the sewers discharge themselves. But on following the stream lower down there was a progressive improvement, the water being purified by the oxygen of the atmosphere and the action of vegetation. At the distance of 14 kilometres below Breslau, or in English measurement a little more than 9 miles, Dr. Hulwa found that the sewage

matters could neither be detected chemically nor microscopically, and that the water was of the same quality as above the city. The report in full may be found in the "Gesundheits-Ingenieur," a well-known German journal of sanitary science.

These investigations, I presume, had not come to the knowledge of the defunct Commission in its land of shadows.

From Silesia we turn to the State of Delaware. Professor A. R. Leeds, a chemist of well-known standing, has conducted very careful and prolonged experiments on the pollutions of the Passaic and the Brandywine Rivers. He concludes that "there is no foundation in fact for the oft-repeated statement that water once polluted by sewage can never again become safe for drinking purposes." In addition to the action of the atmosphere and of water-plants, he points out that the finely-divided earth washed into the river by rains occludes and precipitates the impurities. The Passaic river, it appears, is pure down to the town of Paterson, where it is polluted by the sewage and manufacturing refuse. Yet 16 miles lower down it returns to a condition of purity little inferior to what it exhibits above Paterson, and serves as a water-supply for the 300,000 inhabitants of Jersey City and Newark. Dr. Leeds writes:—"The river immediately below the town is black with dye-wares; the fish carried over the Falls are immediately poisoned, and I have often seen the foul-smelling and disgusting water covered with their floating carcases." Yet samples taken at intervals of a mile apart down the river show a regular diminution in the organic nitrogen, and a disappearance of the nitrites. To give the actual figures, just above Paterson the albumenoid ammonia was found to be 0·016 grain per gallon; below Paterson it had risen to 0·068 grain; whilst at Broadway Bridge it had sunk to 0·024, and at Dundee Dam to 0·018 grain per gallon. Thus the gradual oxidation and disappearance of the organic matter is distinctly shown. A full account of the observations and experiments of Prof. Leeds may be seen in the "Annual Report of the Chief Engineer for the Water Department to the City of Wilmington, Delaware, for the Year 1882" (Wilmington: James and Webb), and "Pollution of the Passaic River" (Newark: Inglis and Co.); or see "Chemical News," March 30th and June 22nd, 1883 (pp. 153 and 292).

A third case may also be noticed. The River Vesle, above the town of Rheims, is fairly pure. It is severely polluted on its passage through Rheims, which has been called the

French Leeds, but further down it gradually returns to the same condition which it had above the town. These successive changes, first for the worse and then for the better, were shown by the volume of free oxygen held in solution in the water, as determined by De Lalande's process. As the impurities increased this free oxygen very naturally diminished, thus proving, by the way, that such free oxygen does actually serve for consuming organic impurities, and that if these exceed a certain quantity it is all used up faster than it can be absorbed from the atmosphere. But as the stream flowed on the absorption of oxygen continued, and it gradually gained ground and was able to destroy the impurities. By degrees, too, water-plants and animals of higher grades, which were unable to exist immediately below the town, now appeared and completed the work of purification.

I admit, of course, that if the quantity of pollution is too great in comparison to the volume of the river,—if water-plants and animals are poisoned by manufacturing refuse, and if the supply of filth is continuous all along the course of the river,—its waters will fail to be purified by the natural agents above mentioned. But this is a very different proposition from the sweeping conclusion of the Commission. Whether living organisms, present as an impurity in water, are capable of being oxidised and destroyed by aëration, by the action of aquatic vegetation, or whether they are capable of being removed in any other manner, is a distinct question, to which I shall revert below.

The dogma of the Commission is to some extent based upon the analytical method used by them, or, more strictly speaking, by Professor Frankland. I am not about to enter upon a discussion of this method, or to undervalue it in comparison with any other method. But as Dr. Percy Frankland asked his audience to condemn the A B C process for the purification of sewage, upon the strength of an analysis made by that method, I am compelled to bring forward a certain historical fact.

In the beginning of the year 1872 the Native Guano Company, proprietors of the A B C process, were beginning to treat the sewage of Leeds. A formal trial of forty-eight hours was made under the superintendence of the Sewage Committee of the Leeds Town Council. Every hour a bottle of the effluent water was taken and sealed by officials of the Council, and at the end of the forty-eight hours the contents of these bottles were poured into a large vessel, and thoroughly stirred up together. It is therefore evident that any two samples of water taken out of this vessel

[*Copy.*]

RESULTS OF ANALYSIS EXPRESSED

Number of Sample.	Description.	Total Solid Impurity.	Organic Carbon.	Organic Nitrogen.
A.	... ...	107·7	2·179	0·566
—	Bedford Water	108·4	2·042	1·017

	Hardness.		
	Temporary.	Permanent.	Total.
A.	7·9	40·7	48·6
Bedford Water	2·2	32·8	35·0

must have been identical. Two Winchester quarts were filled with this water by the officials of the Town Council, sealed, and despatched to Prof. Frankland for analysis. The one was forwarded direct to London, whilst the other was sent to a gentleman in Bedford, who at once sent it on to Prof. Frankland. Neither of these bottles was ever in the custody of any person connected with the Native Guano Company. The results of the analysis of the two samples were in course of time received by the Leeds officials, the one directly and the other *viâ* Bedford, and are indeed instructive. They are here subjoined. The originals, duly signed, are in existence, and can, I am told, be produced if needful.

Thus it will be seen, if we turn to the most important points, that of these two identical samples the one which had come direct from Leeds is represented as containing nearly double the amount of "previous sewage contamination" which was present in the other! Again, whilst the difference between the two samples in "total solid impurities" and in chlorine is trifling, the difference in "organic nitrogen" is nearly 50 per cent, that in "ammonia" nearly 30 per cent, and that in "nitrogen as nitrates and nitrites" above 80 per cent. What can we think of analytical methods by which such results are reached? Yet it was on the faith of such methods of analysis that the A B C process for the purification of sewage was condemned by the Rivers' Pollution Commission. It is on the faith of one of these analyses, exhumed, so to speak, for the

IN PARTS PER 100,000.

Ammonia.	Nitrogen as Nitrates and Nitrites.	Total Combined Nitrogen.	Previous Sewage Contamination.	Chlorine.
1·550	0·372	2·214	1·6180	14·6
1·020	0·062	1·919	0·8700	14·0

Suspended Matter.		
Mineral.	Organic.	Total.
0·68	0·54	1·22
1·82	0·06	1·88

occasion, that the old condemnation was repeated on March 13th.

I have here to complain of something very like intentional unfairness on the part of Dr. Percy Frankland as regards his attack upon the A B C process. The man who, professing to have given any serious attention to the sewage question, can yet endorse the statement of the defunct Commission, that "after treatment by this process the effluent sewage is very little better than that which is obtained by allowing raw sewage to settle in subsidence-tanks," is, to say the least, guilty of most culpable rashness. Any person who heard Dr. Frankland read his paper would be apt to think that the analysis which he quoted had been made recently, instead of fourteen years ago, and that the sample operated upon had been taken at some place where the A B C process was in actual operation in London. But if we turn to the Report of the "Commissioners" we find the whole history of this analysis. Some London sewage was obtained by the Commissioners, and treated by them by the A B C process, and was then analysed. Who guarantees the correct execution of the process, or, after the figures I have above quoted, the accuracy of the analysis? No check sample could be taken to be submitted to any other chemist. Nay, the Report itself contains an admission that the treatment of the water was not fairly, or at least judiciously, performed. The sewage, we are told, after the A B C mixture had been added to it, was well shaken for five minutes. This alone was enough to prevent the precipitation from

being properly effected. It is surely singular and significant that Dr. Percy Frankland should have contented himself with this old analysis, and never taken the trouble even to inquire whether it and the conclusions based upon it were still applicable at the present day. Surely a wish to deal out even-handed justice would have dictated a different course. I learn that he has since applied for, and I believe received permission, to take samples of the sewage and effluent at Aylesbury. Would not this step have come with a better grace before his paper had been read?

There is another point which here deserves notice. In the Commissioners' analysis quoted by Dr. Percy Frankland the ammonia in the effluent is found to be greather than that in the raw sewage. This is true, but wherefore? In those days of "ancient history," as Mr. Norman Bazalgette not unhappily calls them, ammonia-alum was used in the A B C process, and a certain quantity of ammonia was thus introduced. But for twelve years this ammonia-alum has been abandoned in favour of so-called cake-alum, aluminium sulphate, which contains no ammonia. Now Dr. Percy Frankland either knew of this important alteration or not. If not, his acquaintance with the A B C process and its working is indeed archaic. If he knew of it and kept silence, what shall we say of his candour?

In the analysis of the two identical samples of Leeds sewage quoted above there is an item "total solid impurity." It was the custom of the Commissioners to class everything found in water beyond the oxide of hydrogen as "impurity." So it certainly is from an abstract chemical point of view. But from a sanitary point of view it is no such thing. All ordinary waters contain carbonates and sulphates of lime and magnesia, sometimes also traces of iron and silica. But it is far from being demonstrated that these impurities are detrimental to health. In fact the balance of medical opinion seems to incline to the conviction that soft waters—*i.e.*, those free from such "impurities"—are dietetically inferior to moderately hard waters. Surely, then, to speak of such matters as "impurities" in documents drawn up in the interests of public health, savours strongly of sensationalism. It was a great misfortune that the Commission did not include at least one physician.

I come now to the consideration of the living organisms —bacteria, or other microbia—which are now commonly supposed to be the agents of infection. The question has been raised whether these "germs," if present in sewage, can by any treatment, chemical or mechanical, be either

kept back from entering the streams along with the effluent, or, if not kept back, can they be destroyed by oxidation or by any other process? Professor Frankland seems to have attended and testified that these "germs"—like nuisances generally—are very tenacious of life. He told his hearers that they might be boiled for three or four hours without being destroyed, and that they were little affected by cyanogen and sulphurous acid. Dr. Jabez Hogg, the eminent microscopist, also declared that oxidation in the flow of a river could have little effect upon living organisms, however efficient it might be in the removal of dead organic matter. All this may, for argument's sake, be very well admitted, though it is important to note—as Sir Robert Rawlinson pointed out—that cholera can at all events originate on a very large scale independently of germ-polluted waters, whilst that disease may rage in one town, and another town situate lower down the same stream, and using the contaminated waters for domestic purposes, may entirely escape. Cholera has also not unfrequently been known to work up a river, instead of following the current. Such facts as these, I submit, ought not to be entirely overlooked in speculations on the spread of zymotic disease.

But to return: if disease-germs, when once in a river, cannot be destroyed, the question remains whether such germs, if present in sewage, can by any mode of treatment be kept back. Dr. P. Frankland made the honest admission that "there is absolutely no evidence that morbific matter, if present, would be removed" either by irrigation or "downward intermittent filtration." He even stated that, "On the contrary, there is very strong reason to believe that these processes of purification offer no sort of guarantee that noxious organised matters present in the sewage may not pass through into the effluent. For the removal of organic matter by means either of irrigation or intermittent filtration depends upon the oxidising action which a porous soil exerts upon such matter, and is quite analogous to the purification of water percolating through a few feet of soil into shallow wells. Now, the instances on record of the percolation of sewage into shallow wells becoming the means of infection are so numerous and well authenticated that it is unnecessary for me to refer to them here. . . . At Stuttgart in Germany, and Winterthur in Switzerland, some years ago, epidemics of typhoid fever were proved most conclusively to have been caused by the contamination of the water-supply with the effluent from irrigated meadows." Dr. Jabez Hogg cited the well-known case of a stream in

Switzerland which soaked through an entire mountain of oolitic rocks, yet on emerging into another valley was found to have brought with it the infection of typhoid fever.

The present writer has seen flocks of sewage fungus along with the effluent from a large, fairly deep, and well managed sewage irrigation farm. Surely, then, it may be contended that the main ground for the alleged superiority of sewage-irrigation to precipitation processes is substantially abandoned by the above-quoted admissions of Dr. Percy Frankland. He, indeed, argues that if filtration cannot remove disease-germs, so *à fortiori* cannot precipitation—a mistaken inference. There is, in the first place, no evidence that the proportion of organic matter in water bears any constant ratio to the number of disease-germs which it may contain.

If we accept to the full the germ theory we must admit that if the dejecta of a single cholera or typhoid fever patient be thrown into a pure mountain stream, the effect upon the health of a community lower down will be more serious than if the sewage of an entire village had been poured into it. Hence determinations of organic nitrogen and organic carbon, and "previous sewage contamination," throw surprisingly little light upon the safety or danger of using a stream as a domestic water-supply.

But there are facts which prove that precipitation processes—all those at least which employ aluminous salts as precipitants—are not less, but more effectual, guarantees against the presence of disease-germs than any filtration or irrigation process.

For centuries it has been customary in China to add to suspicious and polluted waters a pinch of alum, strain off the clear liquid after standing for some little time, and use it for drinking or cooking. For some years the French troops in Cochin China suffered severely from dysentery of a very malignant kind. It was observed at last that if this Chinese expedient was used persons drinking the water escaped the disease. The microbia are not necessarily killed, but are precipitated and remain in the sediment.

So decisive is this reaction that Dr. Brautlecht has introduced it as a means of detecting bacteria, &c., in waters. He makes a solution of sulphate of alumina, acidulates it with hydrochloric acid, and adds a few drops of this liquid to the water he is about to examine. A few minutes afterwards he adds cautiously a few drops of ammonia, so as to neutralise the whole. A precipitate is formed which carries down with it the bacteria. It is filtered off, re-dissolved in

a little acetic acid, and thus presents the microbia, if any, collected together in a small bulk of liquid. This process is substantially what is done in the A B C process, the other ingredients having different duties to perform. If, then, Brautlecht's method is worth anything, effluents which have been treated with an aluminous salt are much more likely to be free from bacteria than is any filtration effluent.

It is a remarkable and instructive fact that the majority of those authorities who in former days denounced sewage-precipitation in general, and the A B C process in particular, have been led, on further observation and reflection, to modify their views. Is the ghost of the Rivers' Pollution Commission to form the only exception?

It must be noticed that I do not enter into the general question whether the Thames is an eligible source for the water-supply of such a city as London. If it can only be made so by the entire exclusion of sewage, purified or raw, either the use of water-carriage for human excretions must be totally stopped along its course, or a large proportion of its water must be cut off. Dr. P. Frankland, though his wrath seems mainly directed against the A B C process, yet admits that the drainage from cultivated lands, manured as they often are with human excrement, is a source of danger.

But suppose that the Thames is abandoned as a water-supply, and that in its stead we have a gigantic aqueduct, bringing an artificial river of soft water from the mountains of Wales or Cumberland, or even from Scotland,—will, in this case, all danger to public health be removed? Mountain waters often contain traces of lead, and soft waters—such as are used in certain towns of the north of England—act upon the lead service-pipes to such an extent as to be dangerous. Constant lead-poisoning would be, I submit, fully as serious an evil as an occasional outbreak of typhoid fever.

IV. JOTTINGS IN SOLAR PHYSICS.

By A. H. SWINTON.

ASTRONOMERS have long noticed that one half of the sun's face is frequently very much more spotted over than the other half, so that as it rotates on its axis every twenty-five days and a fraction the spots turn towards and away from our globe, much as a revolving light blinks out its warnings to the mariner at sea. If, then, the sun-spots indicate progressive changes transpiring in the luminous disk of the sun, and revealed to us in the writing of the magnetograph, and if these changes are in any way connected with the amount of light and heat emitted by the disk of the sun, we should then certainly expect to find these sun-phases mirrored in the terrestrial phenomena which surround us. At the commencement of last spring I devoted considerable attention to watching the sun's disk, and noted down carefully these minor times of spots and no spots, which with the telescopic power employed appeared to be of very unequal duration, although it is not at all improbable that they ran through their appointed cycles and periods. Thus when I began my diary at the end of January I observed no spots. One solitary spot came round on the left of the sun's disk on February 1st, and inaugurated a period of sun-spottiness that terminated on the 21st of the month. The sun's disk then appeared clear until the 25th, when some spots came round again. They continued visible till about the 28th, when they were on the point of disappearing round the right side of the sun's disk. Then ensued a period of no spots that lasted until March 8th, when the great army of spots was round again. They did not disappear until after April 24th, so that at this time it would seem that the *entire superficies* of the sun was spotted over. For a brief period, from April 29th until May 5th, I observed no spots.

We then have apparent times of sun-spots, indicating hidden phases of the sun, that doubtless have their cycles and periods. In connection with the times of spots and no spots I noted down any sudden atmospheric changes and any record of earthquake shocks I met with; and here, I think, I fairly detected a coincidence. Thus on February 28th, when the spots were on the point of disappearing,

news came of earthquake shocks having been felt in New England at several points; and on March 5th, just previously to the phase of sun-spottiness, there was a severe shock of earthquake felt throughout Cyprus. Between April 29th and May 5th I observed no sun-spots and remarked no earthquakes, nor do I think that they were prevalent the first week in August, when I observed but one small sun-spot. During the great seismic calamities of the year I conclude the superficies of the sun was much spotted over, but I did not detect that the appearance of spots of large size or great groups was in any way directly connected with the record of earthquake disaster. However, if these few imperfect observations be of any real weight they would point to the fact that we have, working at observatories, magnetographs, which either record the minor sun-phases or the energy of the spots on the sun's disk; and the inference is that these instruments might be found to be writing down warnings of disaster could we only read the sudden dashes and long lines.

Mechanical laws regarded as constant, and a statical condition assumed, the rudiments of Physics render it evident that changes in the heat of the sun must cause the surface of the globe on which we live to expand and contract, inasmuch as a milk jug chinks to the frost or the embers crink as the fire subsides.

Again, terrestrial laws considered uniform in operation, a sudden access or diminution in the heat received from the sun should likewise modify the fluctuations of the atmosphere and currents of the ocean, and these modifications, according to the statical law of fluids and the theory of displacement, should be universal, inasmuch as when a fire is kindled draughts arise from all quarters of an apartment, or as water when warmed commences to eddy. Sometimes it indeed would appear that, *whether* from the direct rays of the sun or from an influx of a current of heated air, the sun-spots associate themselves with a spell of abnormal heat, as was the case last year from June 28th until July 4th; or again, in regard to the heat-wave that passed over England between the 6th and 8th of October.

During this brief and genial Martinmas summer the male starlings at this place were deceived into renewing their rattling Hymenean calls, as if Spring had already breathed over the land, and every chimney-top and high branch had its noisy chorister. I likewise noticed the following meteorological coincidences:—The barometer rose when the spots disappeared from the disk of the sun on

February 21st, and when they disappeared on April 28th the weather—after having been cold and chilly for a week—turned suddenly warmer. The Java eruption, singular to say, coincided with a spell of warm weather in this country, which commenced on August 17th and broke up on the 29th. It is singular that working meteorologists should hold a difference of opinion as to whether the sun is hotter or colder when it is spotted over, as this causation is the source of all solar physical theories: from the naturalist's point of view it should be, I think, with little doubt, colder.

Mr. Norman Lockyer, a little time ago, informed us that an examination of the percentage of total wreckage, posted on the loss-book at Lloyd's, showed that between 1856 and 1876 most vessels had been lost at the times of maximum sun-spots, and it appears that a return recently issued and made public in the daily papers greatly confirms this statement. It shows that there has been a decrease in the number of sailing vessels wrecked, commencing with the year 1874 and ending at the year 1878, when sun-spots were fewest, and a corresponding increase commencing with the year 1878 and ending at the year 1882, when sun-spots were at a maximum. For example, in 1874, 214 sailing vessels were lost at sea; in 1875, 167; in 1876, 154; in 1877, 156; in 1878, only 129; in 1879, 140; in 1880, 132; in 1881, 205; in, 1882, 194; in 1883, 163. As these statistics involve a large factor in regard to the sacrifice of human lives, it might suggest that a law should be enacted regarding the over-freighting of vessels when perils are so imminent. It would seem here the rule that at the sun-spot maxima about *twice* the number of sailing vessels have been lost. The *local* wreck chart, of *our coast* of course, gives less precise statements; it shows that between 1854 and 1882, as far as I gather, there have been fewest wrecks between the two opposite sun-spot phases, and most at the two epochs,—a matter which has doubtless affected insurance, although the chapter of accident has been fairly represented. On the other hand, it has been remarked that at the sun-spot minimum, or during the years 1877 and 1878, there was an increased loss of life in mines in the United Kingdom, without doubt owing to an increased emission and accumulation of fire-damp under certain atmospheric conditions.

In the commercial centres of the United Kingdom the economical aspect of Solar Physics is felt to be of moment, and there exists an unquiet feeling in respect to how much is to be believed and how much discredited. Quite recently a north-country daily paper undertook to review the

Government "Blue Book" on the subject, the misconceptions of the compiler being used as an argument against the endowment of research. "How is it," asks the reviewer, "that a year exceptionally *wet* in Britain was exceptionally *dry* in Mauritius? At Calcutta, the rainfall in the maximum year *was very considerably* less than in *either* of the minimum years, while at a large number of stations the year *after* the maximum was *wetter* than the maximum year itself." The answer to these arguments evidently is, there never was a general rule without local exception. As a point in fact the writer states that the heaviest British rainfalls in the century have been in 1852, 1866, and 1872, quoting the "Astronomical Register" for August, and he enquires how any phase in the sun-spots is here indicated. At the outset, however, this is evidently a manifest discrepancy with Symon's Table of British Rainfall, which gives 1852, 1860, and 1872 as the wettest years. But in reality both quotations must be qualified, since the rainfall diagram requires to be equalised in the same manner as the chart of magnetic variation before the causation can be properly seen; and when this is accomplished it then becomes very palpable that there has been during the present century a rise at the maximum of sun-spots, and a supplementary rise, more or less pronounced and less in degree, at the minimum. For instance, a maximum of sun-spots occurred in 1848,—or more properly between the years 1847 and 1848,—and in 1848 and 1852 the rainfall was excessive, so that the effect of the sun-spots may be traced continuously from 1847 until 1852, as is seen also in the chart of Greenwich declination. The next epoch of sun-spots was in 1860, the rainfall of 1866 being accredited to the succeeding minimum; and the next in 1870. The rainfall of the later epoch, however, did not commence until the following year, and it attained a maximum in 1872, while the magnetic declination at Greenwich reached a maximum during 1870, and continued until 1872. What is *wanted* is men *of* various endowment.

V. HYLOZOISM AND HYLO-IDEALISM.

By C. N.

"The question of the *anima mundi* and *anima hümana* is at bottom one and the same. . . . If matter acts by means of its own *vis insita*, and depends on no extraneous influx, or impulse, the whole problem of Immaterialism and Materialism, Supernaturalism and Naturalism, is solved in favour of the latter."—*Life and Mind on the Basis of Modern Medicine*, by ROBERT LEWINS, M.D.

"The philosophy of the earlier Ionic physiologists is Hylozoism,—*i.e.*, the doctrine of the immediate unity and matter of life, according to which matter is by nature endowed with life, and life is inseparably connected with matter."—UEBERWEG'S *History of Philosophy*.

THE blind Galileo lamented that he who had peopled the visible heavens with new worlds, and widened by well-nigh unimaginable spaces the boundaries of the known Universe, should now be imprisoned in the dark and narrow limits of his own bodily frame. It was a pathetic complaint, and not pathetic only, but significant of that genius which in the noblest intellects has power to unify Science with Philosophy and with Poetry. To Galileo discoveries were creations. The moons of Jupiter did not exist for the human race till revealed by his telescope; the myriad stars of the Milky Way were mingled in an indefinite haze, until, seen through his "optic glass," they started into bright distinctness.

What is unknown and unconceived is virtually unreal. "Let there be light" is a useless mandate unless there are eyes and a brain which can translate stimulus into sensation, and extract colour and form from hueless and formless impulses. Yet the mighty astronomer spoke only a partial truth. The loss which he mourned was in reality the loss of an inner, not of an outer, world; for the keenest vision of the most sublime intellectual exaltation could never have enabled him to transcend the limits of his own mind and his own organism. The God within had been robbed in part of his creative power. Sounds and scents and tastes and touches were still produced in the Microcosmos, but the source of light was extinct.

The successors of Galileo have not attended to this lesson. They terrify us with material vastness and splendour. They bid us contemplate astronomic cycles, which can indeed be measured, but can never be comprehended; vast, cold, black

stretches of interstellar space; suns tenfold, twentyfold, a hundredfold more brilliant than ours, whose light travels earthward through decades, centuries, or millennia. Then they point to a drop of dirty water, crowded with swiftly darting animalcules, and tell us that the Earth, in comparison with the Universe, is infinitely smaller than that drop in comparison with the Earth, and that we and our individual and national concerns are thus of incalculably less relative importance than the family life and polity of *Rotifera vulgaris*. To all this we have listened *ad nauseam*. We are beginning to reflect that majesty which may be measured by a foot-rule is a cheap kind of majesty after all, and that the exultation of popular lecturers in the sublimity of the Cosmos (which they seem to consider their own private and exclusive domain) is a little like the pride of a Limited Company in the ownership of the largest gasholder in the world. We feel inclined to retort—Call us Rotifers if you will; but remember that we are Rotifers who can perceive our environment, and that until perceived this environment is void, unshapen, and altogether null. Were the rotiferal consciousness capable of shaping forth the orbs of heaven, the consciousness would be superior to the orbs. It is true that our spheroid home makes a short circuit through space, and that the comet of 1811 makes a long circuit. It is true that the glory of Sirius surpasses the glory of our sun; but light unseen and unthought is not light, and Sirius owes his splendour to the human imagination. Every man fashions and contains a Universe; and it is at least difficult to understand why the importance of the mind should be in inverse ratio to the magnitude of its contents. To be cowed before our own mental furniture is to resemble the mushroom millionaire, abashed by the size of his new house and the magnificence of its carpets and mirrors. Let us imitate neither his first bashfulness nor his subsequent brag, but learn to move easily about our mansion, as if to the manner born.

Since the days of Copernicus, Kepler, Galileo, Newton, we have nearly had time to grow accustomed to our surroundings. Mankind begins with Geocentrism, passed onward through Heliocentrism to the conception of an uncentred Universe, and must now reconcile their conflicting impulses in Autocentrism. The Geocentric ideal was narrow and mean. The small parish of Earth regarded other regions of the Empire as minor adjuncts to its own glory, and the local King was popularly supposed to rule in accordance with this notion. Heliocentric and Acentric ideals

were wider, but cold, comfortless, incomplete. Earth now became a part of heaven; but it had been weighed in the balances and found wanting, and there was an end. Nothing was said about forces which could not be expressed in units of gravitation. One throne of the village monarch became uncertain, and his policy doubtful and inconsistent.

The Autocentric ideal is wide and lofty as thought, clear and vivid as sensation; for sensation and thought are the ultimate standards to which we can appeal. A world-wide Self governs the new Empire. The former King is now recognised as a subject; nay, as the offspring and semblance of the rightful lord. As fire and steam and electricity have been tamed to the will of man, and changed from foes to servants, so the awe and self-contempt and shuddering sense of insignificance once inspired by the broadening of the heavens is now reversed, and made to enhance a thousand-fold the sense of human dignity.

This is an illumination which cannot be wholly rejected even in the present age of speechifying and specialism, of mystical mathematics and transcendental chemistry. Scientific theorising, indeed, has its appropriate and worthy place. It is valuable as subserving either practical use or philosophic truth, which in its turn aims to be the minister of daily happiness. Special researches must doubtless be pursued by many who will never be able to connect their theories with larger generalisations, and who are from that very cause all the better theorists on their own ground; but there is no reason why the minds of such intermediate workers should not be exalted by the feeling that their particular lines of operation may converge towards the highest point of thought, and reinforce the divergent lines issuing thence to the broad plane of action. The artist who decorates the altar with inlaid marbles could not plan the cathedral, but he knows that his work is to be a harmonious part of the general design. The station-master must not fancy that the terminus of the line is, or ought to be, at his little country town. He may never visit the great city himself, but the very fact that there is a great city which he helps others to visit should exercise some widening influence upon his mental horizon.

Physiology teaches that without sensation there is no soul, and that without specially organised matter there is no sensation. It further teaches that the world, as we know it, is composed of sensations variously combined, and is produced within that "crumpled pocket-handkerchief" called the cerebrum. And on this seemingly narrow

foundation must be built whatever philosophy the future has in store.

With that which lies beyond thought and perception we can have nothing to do; nor can we have very much to do with thoughts and perceptions which shine dimly through long spaces of years. As well might we feign that the light of some distant star, reaching us after a journey of two millennia, is the guide and strength of our life. If it be true that the worth of human conduct consists neither in its somatic or spiritual source nor in in its finite or infinite duration, but in its own intrinsic quality; that man has made God in his own image, and worships only Self; that all knowledge of others is a form of self-knowledge; and that all sympathy is based not on mere kinship, but on real solidarity—if this be true, it is clear that we have the outlines of a system which is no mere speculative philosophy, but must affect every relation of practical life. And the validity of this system admits of support or illustration from every department of Physical Science.

Let us glance along any one of the lines which radiate from the democratic substratum of questionable shapes, neither wholly animal nor wholly vegetable, and bear, as their crowning product, some highly specialised aristocrat. As the line passes upward new qualities appear,—sometimes so suddenly that there is a temptation to invoke supernatural agency, and to account for the Inexplicable by ascribing its origin to the Unthinkable. Yet, looking closer, we see that there is no attribute of man or of imagined angel which has not its quaint parody in a lower rank of being. Human volition and the "little living will" of the Nautilus differ in degree, in power, in variety of manifestation; but the difference is specific, not generic. The decorated assembly-halls of the Australian bower-birds are not more distinctly related to the artistic achievements of man than is the whirling dance of the *Rotifer* to the manifold activities by which man earns a living.

But there is a class of phenomena even more worthy of note than these traces of family likeness, even more instructive than direct evidences of a common line of ancestry; because a certain section of the class has been selected by Dualists as the basis of their strongest argument. "How is it," they triumphantly enquire, "that personal identity persists through the constant flux of molecules; that the man who daily dies by inches, and is in like manner regenerated, feels himself to be the same man from month to month, and from year to year? How is it that he remembers

past actions, performed by muscles and directed by a brain of which not one cell or fibre now remains intact?" These questions certainly cannot be answered, but a practical refutation of the suggested inference may very easily be found.

The phenomena of personal identity form by no means an isolated group, and do not testify to anything anomalous in the position and nature of man, or of any other conscious being. This survival of self amid the daily decay and renovation of its physical basis is but a special case of that persistence of function amid mutations of matter on which depends the reproduction of individuals, varieties, and types. The elm puts forth every March its green clusters of flower-buds, protected by brown scales. It never varies very widely from the fashion of colouring and grouping observed by its ancestors for generations back. Purple-tipped perianth, purple-tinted anthers, cleft stigma with delicate crimson fringe—all are according to tradition. Advocates of the old "*emboîtement*" theory had a very convenient way of accounting for such facts as these: they held that the unfertilised ovule already enfolds in miniature every part of the perfect tree—trunk, branches, leaves, flowers, and fruit; and that the animal or plant cannot develop a scale or a hair which was not latent in the embryo. Growth, they said, is simply the absorption of nutriment. The change is not in form, but simply in size. Moreover, every germ is indestructible, and has endured from the beginning of the world. It contains all its progeny down to the end of time, and was itself contained in its remotest ancestor.

This plausible though baseless hypothesis, it will be noted, "explained" the riddle of personality as well as the riddle of heredity. Body and brain were moulded on an extensible framework, gradually distended during the period of growth, and gradually collapsing during the period of decay. There was an outline to be filled up and overlaid with divers colours; and when all these were washed out the original sketch still remained. The idea, though of course long ago discredited, had at least one merit. It showed some appreciation of the connection between two sets of facts, usually considered apart. The problems suggested by transmission of family traits, and by preservation of individual traits, are substantially identical; and since the soul-theory fails to suggest a *rationale* of the former, it can no longer be applied to the solution of the latter. When we know why the man is the father of the child, we shall also know why the child is the father of the man.

Descending from the organic to the inorganic world, it may seem at first sight that nothing analogous is to be expected. Yet if the body of man be modelled by an indwelling spirit, the presence of a similar architect is surely required to account for the structure of a crystal. The crystal, indeed, does not *exchange* particles with the surrounding medium ; it does not assimilate or excrete. Yet it is able to preserve a virtual identity amid material changes. Fracture it, and suspend it in a saturated solution of the same or an isomorphous salt, it attracts the kindred molecules, repairs the injury, and grows to an enlarged likeness of its former self.

But the generalisation which I have tried to indicate admits of a far wider statement. Phenomena such as growth, reproduction, crystallisation, in which the primitive form is (with some variations) preserved or renewed, are only special instances of the operation of an evolutional energy, universally inherent in Matter. From its analogy with human action, the part which this energy plays may be described as *purposive*, and its manifestations are to be sought wherever function determines structure,—that is to say, wherever similar properties, belonging to bodies which may in other respects be like or unlike, produce similar results. The force which induces sodium to combine with oxygen, or hydrogen with chlorine, and permits the combination only in certain definite proportions, is as truly architectonic as the force which evolves the embryo from the germinal vesicle. Kepler believed that the planets were guided in their elliptic orbits by angelic pilots, and the idea was worthy of an age which installed a separate spiritual Archæus as president of every organic function. But we now know that the Angel which moulds, moves, and directs each planet can be none other than the inseparable energy which inheres in every atom of its mass.* Shall we demand any other Angel as Archæus of the human brain ? The monarchs of heart, liver, and stomach have long since been consigned to oblivion.

We have now traced along two distinct lines of argument the essential unity of man with his environment. We have seen that he is the procreator of the phenomenal world ; that, by a wondrous alchemy, the delicate cells of the cerebral hemispheres convert stimuli into sensations, and combine sensations into perceptions ; that in his mind the

* " Our great English geometrician, by his discovery of universal gravitation, was the real founder, in Christian times, of scientific common-sense Materialism."—*Life and Mind*, p. 13.

visible and tangible Cosmos lives and moves and has its being. We have seen, also, that the real or noumenal world is everywhere alive with the same architectonic activities which culminate in the human Ego; and that the formative "Spirit" is a purely material energy, not less necessary to the sand-grains of the sea-shore than to the molecules of the cerebrum.

V. ON SELF-MUTILATION IN THE LOWER ANIMALS.

IT is maintained that a rat if caught by the leg amputates the limb with its teeth, and escapes. We have heard the same thing said concerning wolves. We have been told by a friend that in the Orange Free State he went out one morning, in company with a Boer, to inspect a trap which the latter had set for some plundering baboons. On coming within sight they found that one of the tribe was caught. Thinking him secure they approached very deliberately, and were surprised at seeing the animal suddenly wrench himself away and disappear among the rocks, leaving, as we were told, a part of his leg in the trap. We cannot guarantee these statements, and we have strong doubts whether any warm-blooded animal—especially one so near of kin to man—could survive so rough-and-ready an operation. It is, however, a well-known and common fact that animals belonging to various groups occasionally perform a mutilation of some of their members in order to escape from an enemy. We know that the blind-worm and the lizard can break off their tails, and that a number of crustaceans, spiders, and insects if caught by a leg throw it off and flee. How readily this is done by that corn- and grass-destroyer the crane-fly, or daddy-longlegs, is a familiar circumstance. Many observers must have seen this insect leave in this way a leg in the web of a spider, and have noted the evident surprise of the latter on finding a limb without a body. It is also on record that an *Epeira*, the well-known geometrical spider so common in our gardens in the autumn, having

been bitten in the foot by a *Tegenaria*, amputated the envenomed member.

Such cases of self-mutilation have been of late carefully studied by M. Léon Fredericq, especially as regards crabs. The results of his interesting observations have been made known in the "Archives de Zoologie Experimentale," and in the "Naturforscher."

He establishes, in the first place, that this process of mutilation is performed in the same manner on any leg, and, if it so happen, on every leg of one and the same animal in succession. The fracture always takes place at one and the same part of the leg, in the continuity of the second joint, counting from the body, and leaves a rounded sharply-marked surface. This part is by no means characterised by unusual fragility. On the contrary, the leg of a dead crab possesses a great power of resistance, and bears a strain of several pounds without giving way. When actually broken it has an uneven surface, and the fracture scarcely ever occurs in the continuity of the second joint.

Experiments on the conditions in which the living animal throws off its leg prove that a fracture is effected at the point in question by an energetic muscular contraction. The limb is invariably broken off if the nerve of sensation of the leg is strongly irritated. M. Fredericq found it possible to induce self-amputation by applying a mechanical irritation to the sentient nerve of the leg at a more peripheric point. If this irritation is less marked, as for instance by gradual section of the leg, the animal does not react by self-amputation. If, however, the end of the nerve thus exposed is moistened with alcohol, the crab replies to this chemical irritation by an amputation at the second joint. If the leg is heated the thermic irritation at once produces a fracture at the same place. It was also found very easy to bring on amputation by applying electricity to the nerve. These last experiments permitted a measurement of the time. It was found that the interval between the irritation of the nerve and the rupture of the leg is very variable, ranging from a few hundredth parts of a second to an entire second, and even more.

After these experiments had sufficiently proved that the amputation of the legs in crabs is a reflex process, M. Fredericq endeavoured to ascertain the nerve-centre which is the seat of the mechanism. The removal of the ganglia of the throat had no influence on the phenomenon. But if the ventral ganglia were destroyed the reflex mechanism was annulled. The entire leg might then be cut off without

inducing self-amputation. The direct application of electricity to the ventral ganglia induced in one case the amputation of a leg.

These experiments prove that the self-amputation of the legs of the crab is a purely mechanical process, in which the will of the animal is nowise concerned. This is still more clearly proved by the following experiment :—A captive crab, held fast by one leg, will exert himself to escape until quite exhausted, without ever coming upon the idea of escaping by throwing off the leg. If, however, the limb in question is pinched, or if the nerve of sensation is irritated in any other manner, the fracture ensues at the usual point.

Lastly, M. Fredericq has sought out the last remaining link among the organs concerned in this strange process,—the muscles whose action mediates the fracture. He found that the integrity of the extensor muscle of the second joint is the essential condition for effecting the fracture. It is also necessary that the leg and the distal extremity of the second joint should find a resisting fulcrum,—either the finger of the experimentalist or the shell of the animal itself.

It must still be noted that this reflex amputation is never attended with loss of blood, probably because the muscle which effects the rupture remains contracted.

M. Fredericq has observed such self-amputations in the lobster and in various crabs, in the hermit-crab, the shrimp, &c.

Subsequent observations made by M. Fredericq on a blind-worm have convinced him that the shedding of the tail is effected here also by muscular contraction, and does not depend on any fragility of the part, as the name *Anguis fragilis* would seem to imply. To a dead specimen which weighed only 19 grms., a weight of 490 grms. had to be appended in order to tear off the tail. If a living blind-worm was suspended with its head downwards it twisted about in various directions, but without escaping by breaking off its tail ; but if the end of the tail was strongly irritated a series of lateral movements took place below the point of suspension, with the final result that the tail broke off, whilst the animal fell to the ground and fled.

It was again caught and suspended by the stump of the tail. If the stump was rubbed with the fingers the animal broke off again immediately below the point of suspension, by the same mechanism of alternating contractions to the right and the left side of the body. Hence it appears that, just as in the case of the crab, we have an active fracture—

a muscular movement of a reflex character, induced by irritation of the sensient nerves of the tail. The phenomenon differs, however, in one respect, in the crab and in the blindworm. In the former the fracture is effected at one only point, whilst in the blind-worm several pieces of the tail may be thrown off in succession.

The portions thus amputated by the animal retained for more than ten minutes an alternating lateral movement to the left and the right. These movements ceased at once if the spinal cord was destroyed, but otherwise became gradually fainter and ceased, but reappeared on irritation. Microscopic examination showed that the fracture took place in the level of the sinews, and never in the contractile substance of the fibres.

Experiments with a lizard, several spiders, and insects convinced M. Fredericq that these animals display the phenomenon of an active self-mutilation.

[Without questioning the accuracy of the observations of M. Fredericq, and of the conclusions based upon them, we must be permitted to doubt whether the latter are applicable to all cases of self-mutilation. On two occasions we have seen a *Tipula oleracea* fall into a cobweb, and escape with the loss of a leg. Here there was no irritation applied to the foot, and the leg yielded merely to "a long pull, and a strong pull, and a pull altogether," just in time. The case of the *Epeira* is open to doubt. The observer thought that she was intentionally amputating the leg lest the venom should extend up to the body; but it is possible that the irritation of the bite of the *Tegenaria* may have led to a reflex fracture. It is said that lobster-fishers dread a thunderstorm, as the captive lobsters sometimes shed their claws. Is this assertion capable of being verified? If so it does not agree with M. Fredericq's observations, since the action, though doubtless reflex, is not due to any irritation of the limb below the point of fracture.]

VII. ON THE MECHANICAL RECEPTION OF NUTRIMENT INTO THE INTESTINAL MUCOUS MEMBRANE.

IT has long been known that the assimilation of nutriment in those groups of Protozoa which are destitute of a mouth, or an oral opening, is thus effected: the body, consisting of "sarcode" (protoplasm) emits pseudopodia, which seize upon the particles of food, surround, and imbibe them. In each of the pseudopodia there can be observed a double current of the protoplasm—a centrifugal and a centripetal.

Until recently this mode of taking up nourishment was supposed to be confined to the Protozoa, whilst certain and trustworthy observations were wanting as regards the Metazoa. Latterly, however, some exceedingly interesting results have been obtained concerning the Cœlenterata.

Both in the Sponges and in the true Cœlenterata nourishment is taken up essentially in the same manner as in the Protozoa,—the only difference being that here, in accordance with the division of labour characteristic of the body of a Metozoon, this process is carried on within the region of the endoderm.

The cells lining the nutrient cavity possess, like the entire body of the Protozoa, an active amœboid mobility,—*i.e.*, they retain, to a certain extent, their individuality as independent elementary organisms, and they flow round and envelope the particles of nourishment by means of their pseudopodia, exactly in the same manner as do the Protozoa. This power belongs either to the cells of the entire endoderm, or it is, in other cases, limited to certain regions.

The question now arises whether this method of intercellular digestion extends also to types higher than the Cœlenterata. This, according to the researches of a series of investigators, is actually the case. Thus, in the first place, the amœboid movements of the intestinal epithelium were directly observed in the *Turbellaria*, animals of a very low rank.

Subsequently it was found that numerous *Turbellaria*, whether possessing an intestinal canal or not, take up their nourishment direct into the parenchyma. But not all

Turbellaria display this intercellular digestion. There are some whose intestinal cells have completely lost the power of taking up nourishment,—a fact which is also recognised in the *Rotatoria*, the *Annelides*, and many other worms.

As in the remaining evertebrates—*e.g.*, in the arthropods and the mollusks—nothing has been as yet ascertained concerning intercellular digestion, we might incline to the assumption that the above-mentioned pristine method of taking up nourishment has not been inherited beyond the worms, and that the intestinal epithelium has lost its amœboid character, and has become to a certain degree consolidated along its free margin. We might be disposed to view the strongly refringent basal border, recognisable in the intestinal epithelium of most mammals, as such a solidified outer zone. As regards its more intimate structure various views have been suggested, which, however, by no means fully explain the reception of nourishment as it occurs in the intestine. On this subject the following facts are known :—

The molecules of fatty matter can be traced directly on this passage through the body of the cells. As regards the reception of the albumen we had no definite ground for asserting an active participation of the cellular protoplasm as it takes place in the above-mentioned evertebrate animals. It was therefore assumed that albumen was taken up by means of processes of diffusion and filtration. Although the diffusive power of soluble albumen is too low to explain its necessary abundant transmission into the blood, yet the peptones possess a diffusive power fully sufficient to meet the necessities of the case.

As regards the mucous membrane of fishes and amphibians, Dr. R. Wiedersheim ("Naturforsch. Gesellschaft zu Freiberg," and "Naturforscher") has observed certain facts which are not unimportant in their bearing on this question. The intestinal canal of those vertebrates which are regarded as phyletically the oldest—the *Amphioxus* and the *Cyclostomi*—are completely devoid of pepsine glands, and here, consequently, the formation of peptones is entirely out of the question. The question therefore arises whether here, where a stomach is entirely excluded, there exist in the intestinal mucous membrane arrangements which—in contradistinction to what holds good in the higher vertebrates—permit the absorption of unmodified albumen. The following facts, observed by Dr. Wiedersheim, may pave the way to a direct reply to this question.

In 1875, during an anatomical examination of the cave newt (*Spelerpes fuscus*) he observed in the intestinal canal large extents of ordinary epithelia, which in recent preparations displayed no basal margin. These free borders appeared to him devoid of sharp limits, irregularly ragged, and resolved into fibres. The protoplasm on the free margin of certain cells was engaged in an active amœboid motion. He distinctly observed slow changes of form in the cell-processes, and twice he saw those processes retracted into the body of the cell.

Dr. Wiedersheim further succeeded, when examining living sharks, in confirming an observation of Edinger. The latter found in the mucous membrane of the intestine of fishes a large mass of lymph cells, which even penetrate between the experiments. He further succeeded in proving, by means of experiments with chopped meat, mixed with graphite, that these lymph corpuscles took a distinct black colour. He even believes that he could here and there recognise the black pigment in the interior of single epithelial cells. Hence he considers himself justified in concluding that the intestinal epithelia of fishes, like those of *Spelerpes fuscus*, are capable of amœboid movements.

Although Dr. Wiedersheim has not succeeded in directly feeding the epithelial cells of fishes with granules of pigments, he is still of opinion that both the lymph cells of fishes and the epithelial cells of newts subserve a mechanical absorption of nutriment. The active amœboid movements of the intestinal epithelia have been fully established in vertebrate animals, as well as in many evertebrates. This amœboid motility of the cells he regards as a primeval heir-loom from the lowest vertebrates. He does not, however, deny that with the decrease of the individual activity of the single cells their universal mechanical power of taking up the most varied kinds of nutriment declines in vertebrate animals, and this the more as the chemistry of digestion begins to play a more important part in consequence of the development of different kinds of glandular apparatus. In other words, we have seen that the original method of taking up nourishment was purely mechanical, depending on the active intervention of the cell itself. This naturally does not exclude a true intercellular chemical assimilation.

In the higher vertebrates—*i.e.*, from the osseous fishes, and perhaps even from certain *Selachii* upwards—the

intestinal epithelia lose the power of taking up solids. In these protoplasm processes of differentiation must appear in virtue of which they appear adapted solely for taking up certain determinate matters which have undergone chemical modifications. In short, the simple cell now, like the cells of glands, displays a selective power with referenec to the matter to be taken up.

This view must be capable of experimental conrfimation in those vertebrates whose intestinal canal is devoid of complex glands, as in *Amphioxus* and in the *Cyclostomi.*

ANALYSES OF BOOKS.

Geology of Wisconsin. Survey of 1873 to 1879. Vol. I. Published under the Direction of the Chief Geologist by the Commissioners of Public Printing.

The liberality with which both the Federal Government and the Governments of the various States of the North American Union distribute the elaborate reports of their surveys and explorations deserves the warmest recognition from the *savants* of all nations. The volume before us consists of three parts, treating respectively of the general geology, the natural history, and the industrial resources of Wisconsin. For the present we shall confine our attention to the second of these sections.

Its first chapter contains analyses of the principal limestones, sandstones, crystalline rocks, clays, soils, and native waters of the State. One of the latter, the Bethesda Spring at Wankosha, presumably free from human contamination, contains the large proportion of 1·983 grains of organic matter per gallon. The minerals and rocks are next enumerated and described, and are followed by a very elaborate catalogue of the fossils.

Next follows the local flora. Turning to the ferns here mentioned, we find a greater proportion of species which Wisconsin has in common with Britain than occurs in most other orders. Thus the common brake, the polypody, the "female fern," and the royal Osmund are as decidedly native in Wisconsin as with us.

In the Lepidopterous fauna we find a larger proportion of diurnal species, the Rhopalocera, common to both sides of the Atlantic, than we do of the Sphingidæ or hawk-moths. This is exactly what we should not have expected, *à priori*, if we take the great strength and swiftness of the latter group of insects into account. We rather demur to the statement that all the hawk-moths are decidedly noxious, as a very large proportion of them feed upon plants which are not objects of man's care and cultivation.

Among the Noctuidæ we notice the great development of the genus *Catocala*, to which the beautiful "red underwings" belong. Of this genus 27 species have been taken within two miles of the town of Racine!

In Chapter IX. Dr. Hoy gives an important catalogue of the cold-blooded Vertebrates of Wisconsin. There are only three lizards. The non-venomous snakes are numerous. Two poisonous

species only are mentioned,—the yellow rattlesnake (*Crotalus durissus*) and the massassanga (*Crotalophorus tergemina*). We cannot agree with Dr. Hoy when he pronounces the Crotalidæ the most deadly poisonous serpents known.

Mr. M. Strong gives a list of the mammals, in which the diet and habits are tersely summarised, and an opinion is given as to whether they merit preservation or extirpation. Most of the squirrels are shown to be decidedly harmful, as destroying corn and eating the buds of trees.

Mr. King furnishes a very instructive chapter on the "Economic Relations of Wisconsin Birds." This report is founded on an examination of the contents of the stomachs of over 1800 birds. "The contents of one-half of the stomachs were examined under the hand-lens on the day they were obtained, while the contents of 750 were transferred at once to small phials containing alcohol, and carefully labelled." This material, by the permission of Prof. Comstock, was studied in the Entomological Laboratory of Cornell University. The author lays down the following preliminary propositions:—A bird renders a service when it is injurious or destructive to plants which are to be regarded as detrimental. Mr. King, indeed, considers that the mere act of cultivation so effectually controls these weeds that but little work is left for birds to do. We can scarcely accept this in view of the persistence, if not the increase, of many of the more noxious weeds. In England, at least, the farmer seems to gain little ground in his war with the thistle, the red sorrel, the groundsel, &c.

Mr. King next states that a bird renders a service when it feeds upon injurious mammals, such as squirrels, gophers, rats, mice, and hares. Further evidence is here given of the damage done by squirrels, especially *Sciurius Hudsonius*, in devouring the eggs and young of the small insectivorous birds. Again, a bird may do service by feeding upon injurious birds and reptiles. Concerning snakes it is pointed out that much remains to be learned. Many species, not directly hurtful to men, do us indirect disservice by preying on frogs and toads, newts, fish, small birds, &c. Hence a snake-devouring bird is to be regarded as beneficial except it has counterbalancing habits.

The greatest service which birds render us is, however, in the destruction of noxious insects. We here meet with a passage against which we must put in a decided protest. Mr. King writes:—"Wherever the English sparrow, the bird so much decried in our country of late, has been exterminated in Europe, noxious insects are said to have followed in such abundance that it has not only been gladly reinstated, but is now protected because it accomplishes what parasitic and predaceous insects are unable to do." If such an assertion is made in any scientific treatise, as distinguished from the mythology of zoophilism, the alleged multiplication of noxious insects will be due to the

fact that true insectivorous birds were destroyed or scared away by the clumsy methods used in the war against the sparrow. In a later part of his work Mr. King expresses an opinion much more in harmony with facts. He writes:—"I believe it (the English sparrow) to be a bird for which we have no present need, and that it is positively in the way of a score of more useful species. The bird has very few of those qualifications, indeed, which are combined in good insect-destroyers, while it has many traits which are positively vicious. One chipping sparrow (*Spizella domestica*) is worth two score of these imported gamins."

The author shows further that a bird may serve men by preying upon slugs and snails. These mollusks are, indeed, much less numerous and destructive in America than in the moister climates of Western Europe.

The mischief done by birds is next considered. It is shown that a bird is harmful if it preys upon earthworms, when it destroys carnivorous insects, spiders and myriapods, and the parasites of noxious species. Here we find ourselves in a singular dilemma. The very same species which serve us are also ready to injure us. Each species fights for its own hand. There is scarcely an insect-eater which entirely abjures fruits and the buds of trees, and when preying upon insects it devours indiscriminately the zoophagous and the phytophagous. This principle pervades the entire animal world. The mole devours the larvæ of the useful *Carabus* as eagerly as those of the destructive cockchafer or daddy-longlegs. The weasel assassinates the mole as readily as the field-mouse.

The number of yet unsolved questions raised by Mr. King is surprising, and many observers must spend years in patient labour before half of them can be solved, even for the United States. We should hope that his treatise will be republished as an independent work; there are few parts of the world where it would not be serviceable. We could wish that similar researches might be undertaken in India, Australia and South Africa, and the West Indies.

Selections from Previous Works, with Remarks on Mr. G. J. Romanes's "Mental Evolution in Animals," and a Psalm of Montreal. By SAMUEL BUTLER. London: Trübner and Co.

WE have here selections from several of the author's former works,—from "Erewhon" from the "Fair Haven," from "Life and Habit," from "Evolution, Old and New," and from "Unconscious Memory." There are also remarks on "Mental

Evolution in Animals," by Mr. Romanes, selections from "Alps and Sanctuaries," and the "Psalm of Montreal," mentioned on the title-page. Two of the works in question—to wit, "Evolution, Old and New," and "Unconscious Memory"—we have had the pleasure of noticing in the "Journal of Science" some time ago. Two others—the "Fair Haven" and "Alps and Sanctuaries"—cannot legitimately come within our cognizance, though they may assist us in reaching a correct estimate of the author's opinions and ways of thinking. To form such an estimate is no easy task. The whole work, indeed, bears marks of an ability which it would be idle to depreciate. But we can scarcely say whether it is richer in ideas of value or in matter to be condemned. The author's views, on most questions, go completely askew of those commonly accepted at home or abroad, in the present or in the past. He sees the world as no one else sees it, and therefore often in a very instructive light.

We must not forget to point out that in all this there is no affected singularity, no straining to be original. By birth and breeding he is a citizen of the realm of paradox. These characteristics appear most strikingly, perhaps, in "Erewhon,"—the strangest, and probably the most repulsive, Utopia ever written. So repulsive, indeed, that were the "Erewhonians" actual beings a crusade for their extirpation would seem not merely legitimate, but imperative. But in reading the chapters taken from this book we are constantly in doubt whether Mr. Butler propounds Erewhon as a model for imitation, whether he is not satirising certain world-betterers and maudlinists in our own country, or whether he is not simply following his natural bent for inverting, reversing, and turning things in general topsy-turvy. He says, indeed, of the Erewhonians,—and the remark is not uncharacteristic,—"The people whose sense of the fitness of things was equal to the upraising of so serene a handiwork" (*i.e.*, an architectural masterpiece) "were hardly likely to be wrong in the conclusions they might come to upon any subject." Surely a most delusive test?

The main peculiarity of the Erewhonians is that they punish sickness, and cure, or pretend to cure, crime. They have no physicians, but in their stead a class of beings called "straighteners," one of whom is voluntarily called in by a scoundrel who has committed arson, forgery, robbery with violence, or the like, in order that he may be restored to moral health,—a most improbable supposition, especially among a community which does not attach to crime the disgrace which it incurs among sane people. It may be useful to meet the sophistry of the judge by pointing out those distinctions between disease and crime which ought to forbid any rational person from even imagining that their respective treatment can be convertible. Disease is a state for the most part entirely out of the control of the sufferer. Crime is an act or series of acts, each

perfectly within the control of the rogue or the ruffian. No person can say that he has a direct vested interest in his neighbour's health, save in the case of infectious diseases. Every man has a distinct interest in the absence of crime from the community. He has, so to speak, a direct personal quarrel with the criminal, which, in civilised society, he hands over to judge, jury, gaoler, and if needful to the hangman. But who can say that he is in the remotest aggrieved if some one in the next street suffers from neuralgia, or bronchitis, or asthma, or gout?

Again, even if for argument's sake we admit the sick man to be a nuisance, we find that he either recovers—and in that case ceases to be a nuisance—or dies prematurely, and then equally troubles us no longer. But the criminal does not cease to commit crime, nor does he, save for the interference of the law, die sooner than he otherwise would have done. The sick man, again, craves to be restored to health; the criminal does not crave to become a law-abiding citizen, though he may be desirous to escape detection and its consequences. Lastly, we can in most cases ascertain whether the invalid is restored to health or not; but we have no means of judging whether the criminal is really "cured," or if he is merely biding his time. This subject, however, cannot be here pursued further, from want of space.

The "Colleges of Unreason" in "Erewhon" are perhaps not such exceptional institutions as the author imagines. For what else, after all, are all our institutions for cram and examinations? Of examinations, indeed, Mr. Butler is not enamoured, though he unfortunately believes that all universities are necessarily examinational.

Turning to the end of the book we find the "Psalm of Montreal," a poem, and one with which we can have little sympathy. Mr. Butler, it seems, visiting the Montreal Museum of Natural History, found a statue of the Discobolus "banished from public view to a room where were all manner of skins, plants, snakes, insects, &c., and in the midst of these an old man, stuffing an owl,"—in other words, the curator's workroom. Mr. Butler was wroth, and "a dialogue, perhaps true, perhaps imaginary, perhaps a little of one and a little of the other," gave rise to the author's lines. To his protest the curator is represented as replying:—

> "The Discobolus is put here because he is vulgar,
> He hath neither vest nor pants with which to cover his limbs;
> I, sir, am a person of most respectable connections,
> My brother-in-law is haberdasher to Mr. Spurgeon." (*Sic.*)

Now the proper reply of the curator would have been that the Discobolus, in a Museum of Natural History, however beautiful in itself, is simply "matter in the wrong place," *i.e.*, dirt. It is also hard for us to believe that any naturalist would bring forward a connection with Mr. Spurgeon as a claim to consideration.

Had he said "to Darwin or Haeckel, to Agassiz or Leconte," this dialogue would have had a greater semblance of probability. The *refrain* "O God! O Montreal!" is little suited to English tastes. To the Theist of every grade it seems irreverent, and to the Agnostic and the Atheist simply foolish.

From an examination of the Preface, as well as from other portions of the book before us, we learn that Mr. Butler's relations with his brother-evolutionists are, as diplomatists say, in a state of tension. He has a difference with Mr. Romanes, and remarks that "It is no longer usual for men of any but the lowest scientific standing to correct their misstatements when they are brought to book. Science is made for Fellows of the Royal Society, and for no one else, not Fellows of the Royal Society for Science; and if the having achieved a certain position should still involve being obliged to be as scrupulous and accurate as other people, what is the good of the position?" Again, "If I had not ere now had reason to set down Mr. Romanes as one who was not likely to be squeamish about trifles." These passages, which we find in the Preface, refer to an error made by Mr. Romanes in asserting that the late Canon Kingsley had sent to "Nature," in January, 1867, a letter on inherited memory. In reality, as Mr. Romanes has since shown, the quotation should have been from "Fraser" for June, 1867. Canon Kingsley there and then, treating of the migration of birds, writes:—"Something told him (the wood wren) that his mother had done it before him, and he was flesh of her flesh, life of her life, and had inherited her instinct, as we call hereditary memory, in order to avoid the trouble of finding out what it is and how it comes." Mr. Butler, however, is by no means fully satisfied. He writes:—"It is plain that he (Mr. Romanes) intends to convey the idea that Canon Kingsley advanced the theory that instinct generally is inherited memory, which indeed his words do; but it is hardly credible that he should have left them where he did if he had realised their importance."

At any rate the publication of Canon Kingsley's words with the exact reference to their source should exculpate Mr. Romanes from the charges brought against him in the Preface. Mr. Butler is not of this opinion. He writes:—"The late Mr. Darwin himself, indeed,—whose mantle seems to have fallen more especially and particularly on Mr. Romanes,—could not contradict himself more hopelessly than Mr. Romanes does." Again:—"Fortunately Mr. Romanes is not Mr. Darwin; and though he has certainly got Mr. Darwin's mantle, and got it very much too, it will not on Mr. Romanes' shoulders hide a good deal that people were not going to observe too closely while Mr. Darwin wore it." It is somewhat singular that whilst Darwin had, in the earlier part of his career, enemies so many, so influential, and so able, any faults or shortcomings of his could remain hidden to be ultimately detected by Mr. Butler!

But we must, for the present, pursue our examination of this strangely interesting work no further, the more as we hope at no distant date to lay before our readers an estimate of Mr. Butler's contributions to the doctrine of Evolution.

A strange oversight, on page 101, demands the author's attention. It is there said that Sir Humphry Davy discovered oxygen.

Proceedings of the Literary and Philosophical Society of Liverpool (during the Seventy-first Session, 1881-82). No. XXXVI. London: Longmans and Co. Liverpool: D. Marples and Co., Limited.

THIS volume is rich in excellent matter. For once non-scientific articles are in a minority in number. One of them, on the "Revision of the New Testament," by Dr. Nevins, seems so unmistakably theological in its character that we wonder its admissibility was not questioned.

We have first to notice a communication on Fresh-water Mollusca from Lake Tanganyika, by the Rev. H. H. Higgins. The author questions whether in all cases the morphology of the soft parts of mollusks affords better indications of blood-relationship than does that of the hard parts. He mentions that he has personally taken from the Sea of Galilee, and from a stream near Jericho, shells resembling those from Lake Tanganyika, and he refers to the conjecture that "the Valley of the Jordan, the Red Sea (then closed at the southern end), the Valley of the Upper Nile, and the great African lakes formed portions of one vast fresh-water lake system in Eocene times." Some of the shells in question, however, imitate marine forms. Mr. Higgins therefore asks whether they are vestiges of a time when Africa was submerged. "If so, we have Mollusca placed in one genus which in their pedigree were wide asunder—a converging instead of a diverging pedigree."

Mr. J. Linton Palmer calls attention to a curious ethnological fact: in the primeval implements hitherto found in the American continent the groove or gouge type prevails in the north, and the straight-edge or chisel in the south.

Mr. E. Davies, F.G.S., the President, delivered an Inaugural Address on Chemical Force. Its characteristic is a philosophic caution. The speaker admits that "in the simplest chemical reactions there is much that we cannot understand. The old philosopher, Kanada, knew as much as we; and *Adrishta*, the Unseen, is still the best name we can give to the chemical force. . . . . Nothing must be accepted as articles of scientific faith

to be accepted under penalty of scientific excommunication. . . . . When we cannot fully explain all that is involved in the formation of a drop of water, I think we ought not to dogmatise on the profound mysteries of life and sensation." This is well put.

"Some Popular Misconceptions of Darwinism," by Rev. S. Fletcher Williams, is a timely paper, though the author in the latter part of his paper uses the term Darwinism in its popular sense, as synonymous with Evolutionism. He combats the prevailing error that Darwinism undertakes to account for the origin of life. He shows that Darwin did not profess to penetrate this mystery, and that, in the words of Prof. Tyndall, the Evolution hypothesis "does not solve—does not profess to solve—the ultimate mystery of this universe." The author next touches the misconception that, according to Darwin, man is only a little more advanced than the brutes. Among the scoffers who make this assertion—one and all we believe ignorant, and contemptuously ignorant, of Biology—is mentioned Mr. Froude, in his Address at the University of St. Andrews. Another current assertion is, that if man has been developed out of the lower forms of life he is in danger of losing his soul and his hope of immortality. The worthy people who are moved by this dread would doubtless shudder if told that most, if not all, of the arguments advanced to prove the immortality of man apply with no less force to the brutes also. But, passing over this difficulty, the author asks—"If we are made out of the dust, where did we get our immortal souls? If we have developed out of some lower form of animal life, is there any more mystery about the soul than on the other theory?" The author justly maintains that "the theory of Darwin does not touch the question of my spiritual nature or my immortality."

The last popular outcry against Darwinism is "that it is godless, atheistic; that it involves the exclusion of God and of design from the universe." This view has found, it appears, an advocate in Mr. Gladstone, who, in his Address at the Shaw-street College, declared that in our time, "upon the ground of what is called Evolution, God is relieved of the labour of creation." We are here reminded of an utterance of his great rival, Earl Beaconsfield, to the effect that in the question as to whether a man was a monkey or an angel, he was "on the side of the angels."

Such sayings are the more to be regretted since, according to a prevailing English superstition, a member of the Privy Council, simply as such, and without any especial study, is entitled to deliver an authoritative opinion on any question whatever.

"On the Justifiability of Scientific Experiments on Living Animals," by Dr. F. Pollard, is an able paper, but the author curiously enough, does not see the argument which completely crushes the Bestiarians. After speaking of the cruelties inflicted

under the name of sport, he goes on to say:—"But I cannot say that they afford any reason why persons who think it better to begin by attacking vivisection should be precluded from doing so until all these pain-giving sports are done away with. Cruelty by one set of people is no excuse for cruelty by another set of people, and it is no justification of physiologists, if they are cruel, that farmers and poulterers, and rat-catchers and angling bishops, and country gentlemen and benevolent ladies are all cruel in various ways, or even that they are more cruel than physiologists themselves." The words we have just quoted prove that Dr. Pollard has failed rightly to apprehend the "inconsistency" argument. We grant that any person who believes that the infliction of pain upon animals is wrong under any circumstances, and who lives up to his belief, might be justified in beginning by attacking vivisection if he thought proper. But any one who does inflict pain, or who procures its infliction by others, has no logical right to say a word against vivisection, unless he can prove—which these worthies never even attempt—that the infliction of pain in pursuit of knowledge is less justifiable than for any other purpose. To the legal quibble that "two blacks do not make one white" (they may do in case of chemical combinations) we oppose the common sense proverb anent the kettle and the pot, or that sterner and more authoritative warning—"Thou hypocrite, first cast out the beam out of thine own eye, and then shalt thou see clearly to cast out the mote out of thy brother's eye."

We regret, further, to find that Dr. Pollard pays a very needless compliment to at least one prominent Bestiarian—that he accepts, in its main features, the disgraceful Act of 1876, and that he expresses no regret for the cardinal blunder of physiologists and of the medical papers in accepting this measure with good grace, in advocating loyal adherence to its regulations on the part of investigators, and deprecating further agitation on the subject. They were warned what the result would be, but they took no heed.

The paper on the "Metamorphoses of Lepidoptera from Santo Paulo, by E. Dukinfield Jones, C.E., a Corresponding Member of the Society, is a most valuable production. Not content, like too many naturalists when visiting tropical regions, with capturing specimens, he worked out the metamorphoses of 83 species, making drawings and giving descriptions of the larvæ and pupæ. He noted their habits, the time they spend in the larva and the pupa state, their manner of flight, the number of broods in the year, and a variety of other particulars. All this good, sound work was done without assistance, and amidst professional duties. The specimens, we understand, are all deposited in the Liverpool Free Public Museum.

The next volume of the Society's "Transactions and Proceedings" will be noticed in our June number.

Bulletin of the Philosophical Society of Washington. Vol. IV.

This volume, containing the minutes of the Society from October 9, 1880, to June 11, 1881, has been late in making its appearance. The first memoir we notice is on the "Animal Population of the Globe,"—a somewhat ambiguous title. It is here taken to mean a census of the domestic mammalia throughout the world. The grand total is taken at about 1500 millions, or substantially the same as the number of human beings. The writer concludes with some remarks on the moral bearings of domestication. He contends that man creates more life than he destroys, and that his methods of destruction are less painful than those of Nature. It may however, we think, be fairly questioned whether any creatures existing in a wild condition lead lives so miserable as those of the majority of beasts of burden.

Profs. Pumpelly and Smythe have been investigating certain important sanitary problems. They find that the filtration of water through many feet of fine sand is insufficient to remove "bacteroidal organisms—a proof that irrigation, or "intermittent downwards filtration," does not deprive sewage of its dangerous properties. The authors confirm Wernich's results, viz., that air passing over putrefying fluids does not take up organisms therefrom—a conclusion which seems to show that the danger of living near a polluted river has been over-rated.

Mr. Simon Newcomb communicated a paper on the "Relation of Scientific Method to Social Progress." The bulk of this paper scarcely comes within our cognizance, but we may legitimately and approvingly quote the following passage:—"I make bold to say that the greatest want of the day, from a purely practical point of view, is the more general introduction of the scientific spirit and the scientific method into the discussion of those political and social problems which we encounter on our road to a higher plane of public well-being." The same writer further remarks:—"I think Prof. Clifford was very happy in defining science as organised common sense. The foundation of its widest general creations is laid, not in any artificial theories, but in the natural beliefs and tendencies of the human mind." Is this so? Was not the doctrine of the rotundity and the rotation of the earth a flat revolt against these same "natural beliefs and tendencies"? Is not "common sense" still vaunted as being the safeguard of the British Philistine against Evolutionism?

Mr. S. M. Burnett, discussing colour-perception and colour-blindness, objected to the Young-Helmholtz theory, and also to the view of Prof. Hering, who assumes that there are in the retina three chemical compounds, which he names the *black-white*, the *red-green*, and the *blue-yellow*. He has devised a plan (published in full in the "Archives of Ophthalmology") for the

systematic education of the colour sense in children. It would be well if all the perceptions were systematically cultivated.

Mr. Gallaudet referred to the proceedings at the International Convention of Teachers of the Deaf and Dumb, and declared himself in favour of the oral method in contradistinction to that of signs.

Mr. J. W. Chickering gave an account of the elevations, the climate, and the flora of the Roan Mountains in North Carolina. The peculiar plants met with, even at altitudes of 6000 feet and upwards, are scarcely sub-alpine, and between 3000 and 4000 feet the forest trees are magnificent. The individual masses and ranges appeared to have been formed by the erosion of a table-land.

Mr. Lester F. Ward read a very elaborate memoir on the flora of Washington and its vicinity. The author describes with some humour the botanist's point of view, which, we may add, is precisely that of the zoologist in every department :—" Rich fields of corn are to him waste lands ; cities are his abhorrence ; and great areas under high cultivation he calls ' poor country ' ; while, on the other hand, the impenetrable forest delights his gaze, the rocky cliff charms him, thin soiled barrens, boggy fens, and unreclaimable morasses are for him the finest lands in a State. The axe and the plough are to him symbols of barbarism, and the reclaiming of waste lands and the opening-up of his favourite haunts to cultivation he instinctively denounces as acts of Vandalism. While all this may seem as absurd to some as does the withholding from tillage of great pleasure-grounds in the form of hunting-parks for the landed sporting gentry of Northern and Western Europe, still, when these parts of the world are compared with the artificially-made deserts of South-eastern Europe and Western Asia, caused by the absence of such sentiments, there may perhaps be dimly recognised a soul of good in things evil, if not a soul of wisdom in things ridiculous."

The author proposes a certain district along Rock Creek, near Washington, as a National Park, and urges its preservation for that purpose.

Passing to details, we find a list of cases of well-defined albinoism in seven species, including a *Vinca* and a *Rhododendron.* Four species have been found with " the flowers much doubled, as in cultivation."

Concerning nomenclature we find a very just remark :—" Some scientific men seem disposed to forget that it is the things rather than the names which constitute the objects of scientific study. There is a vast amount of true scientific observation made by mere school-girls and rustics who do not even know the name of the branch of science they are pursuing. A knowledge of a plant by any name or no name at all is scientific knowledge, and the devotees of science should care less for the means than for the end they have in view.

Touching the popularisation of science we read:—"If it could become as much of a disgrace to be found ignorant of the flora or fauna of one's native place as it is now to be found ignorant of the rules of etiquette or the contents of the last novel, devotees of botany and natural history would immediately become legion."

We are in general ignorant not merely of the contents, but even of the very name, of the "last novel"—would it were written!—but we never felt this ignorance a disgrace, nor have we ever met with any person who had the impertinence to regard it as such.

Mr. Ward does well to point out that while all forms of natural science so far from quenching the æsthetic faculties tend powerfully to develope them, that of Natural History, and especially of Botany, awakens such an interest in Nature and her beautiful objects that those who have once tasted pleasure of this class may well consider other pleasures insipid.

This volume, which we have thus cursorily noticed, affords throughout gratifying proof that the Philosophical Society of Washington is doing valuable work.

Volume V. will be noticed in our June number.

Notes on Natural Selection and the Origin of Species. By Francis P. Pascoe, F.L.S., formerly President of the Entomological Society. London: Taylor and Francis.

The author of this brief but suggestive pamphlet, whilst fully recognising the great principle of Evolution, does not feel free to accept "Natural Selection" as the one great agent in the origin of species. In this view he is far from singular. The saying that before selection can come into play there must be varieties to select among has passed almost into a truism, and we are therefore left face to face with the main question, whence comes the variation? Unlike, however, another recent critic of the doctrine of Natural Selection, Mr. Pascoe holds that "Darwin's object was truth, and nothing could exceed his readiness to admit a difficulty wherever it told against his views."

Mr. Pascoe raises a point with reference to the beetles found in Madeira. According to Wollaston nearly 200 out of the 580 species existing in Madeira are wingless, or at least unable to fly. Darwin accounted for this fact on the principle of Natural Selection, as those beetles which flew most would run the greatest risk of being blown out to sea, and would consequently be the least likely to survive and to leave posterity. But Mr. Pascoe remarks that the beetles of Madeira belong chiefly to the families Curculionidæ, Tenebrionidæ, aud Carabidæ, many of which, even in inland localities, are wingless.

The difficulty—first raised, we believe, by the "Edinburgh Review," and admitted by Darwin—is that variation, though useful, would be generally lost by subsequent intercrossing with ordinary individuals. Yet there are cases on record where an abnormally formed animal, though mated wlth a perfectly normal individual of the opposite sex, has transmitted its pecularities unimpaired, and even intensified, to its offspring.

The following passage is worthy of note:—"We admire the structure of the fore limbs (so well adapted for burrowing) of the mole; but the rabbit, an unsurpassed burrower, is no more adapted for burrowing than its congener the hare, which never burrows; the snake (*Trop. natrix*), without fins, like the viper, is a rapid and graceful swimmer, while the latter rarely goes near the water." Such instances might be multiplied to a large extent. In any case they cut in several directions at once.

On the same page, in a note bearing upon a question which has been lately raised, Mr. Pascoe says—"Without denying the advantages of concealment for safety, I have been struck with the habit of Brazilian butterflies alighting nearly in the centre of a leaf, where, of course, they are most conspicuous: only one exception occurs to me—*Helicopsis cupido*, which almost invariably seeks the under side. I have never seen a bird touch a butterfly." We have lately seen it questioned whether birds ever capture butterflies at all. We must confess we never saw a bird in the act; but we have seen the damaged wings of butterflies, lacking the body, in situations where they could only be accounted for as having been left by some bird which had devoured the remainder. On the other hand, Dr. Fritz Müller, in order to prove that the protection which insects obtain by dint of peculiar odours, mimetism, and the like is far from perfect, forwarded to the Entomological Society a case of butterflies all of which had apparently been struck at by birds. Mr. Bates, too ("Naturalist in Nicaragua," p. 316), speaks of having observed a pair of birds bringing butterflies to their young. But not a few observers whom we have questioned have never seen a butterfly actually captured by a bird.

On one point we must join issue with Mr. Pascoe. He writes: "In the Scarabæidæ we find one section passing their lives in mammalian excreta, and another section living in flowers or among foliage, they having the same peculiar laminiferous antennæ, which on the theory of special advantage should hardly be suitable to both." But all, or nearly all, the Lamellicornes are very limited in their selection of food, and, being for the most part slow crawlers and heavy flyers, they require senses which may direct them at once to their food. We think Mr. Pascoe will find, on examination, that the complexity of the antennæ in insects varies almost inversely as the locomotive powers, and as the development of the eyes.

The matter in the pamphlet before us would have been drawn out by certain writers into a bulky volume.

Geology of Wisconsin. Survey of 1873-79. Vol. IV., accompanied by an Atlas of Maps. Published under the direction of the Chief Geologist by the Commissioners of Public Printing. 1882.

THIS volume deals with the Upper Mississippi region, the Lower St. Croix region, the ore deposits of South-western Wisconsin, the quartzite of Barron and Chippewa counties, the Flambeau region, the crystalline rocks of the Wisconsin Valley, the superficial geology of the Upper Wisconsin Valley, and expounds, lastly, the character and methods of the geodetic survey.

It is especially to be noted to what an extent the evils resulting from the reckless destruction of forests have forced themselves upon the notice, not merely of scientific theorists, but of far-sighted practical men throughout America. We know that not a few authorities are of opinion that all the water of our globe will be ultimately absorbed into its interior, leaving the surface arid. To prevent, or at least retard, this process is within the power of man if he will only use the knowledge which he possesses. But if in that greed which is the dominant feature of modern life he "clears" the country the result is, locally, the conversion of fertile land into a desert, and, generally, an impulse given to the desiccation of the earth.

As regards the quantity of moisture pumped up from the earth bo trees and restored to the atmosphere, Dr. J. M. Anders has made some very interesting determinations. He finds that the average evaporation from soft thin-leaved plants in clear weather is about $1\frac{1}{4}$ ozs. troy for every square foot of surface per day of 12 hours. Hence a single elm, of no very large size, would throw off $7\frac{3}{4}$ tons of watery vapour in twelve hours, and a grove of 1000 trees, oaks, maples, &c., would exhale over 45,000 "barrels" of water during every clear day of its season of growth. It is too much to assume that, without the agency of the trees, this water would all have been restored to the surface by the agency of springs. The author notes that there has been an evident increase of rainfall over certain areas on the plains of Colorado which have been irrigated for five or six years and planted with trees, &c. It seems to him that vegetation has contributed to this result by pumping up the water running beneath the surface. The roots of many trees penetrate the ground to the depth of twenty feet and more.

It is asserted by some that throughout the prairie region of America the annual rainfall is, in three years out of five, sufficient for the purposes of the farmer. The author contends, however, that in the denuded regions vegetation would be improved if the rainfall were more distributed, so as to render the heavy rains lighter and light showers more frequent. In Europe, he adds, floods are known to be more numerous, and in Asia droughts more frequent, since vast forests have been destroyed.

This perfectly true: the desolation of much of Spain, North Africa, Syria, Persia, &c., is due to the same cause. Or to look at a small, and therefore a definite case, we were shown, many years ago, a small stream, a tributary of the Oder, which, within the memory of the oldest inhabitant, turned a couple of corn-mills, but which now, since the forests about its sources have been removed, is throughout the summer merely a dry ravine, save for couple of days after a heavy thunderstorm.

This question has for us, in the home kingdoms at least, little direct practical interest. The denudation of Great Britain and Ireland affects the farmer and the gardener more by giving play to bitter winds than by preventing showers, which, like the poor, are "always with us." But in India, Australia, and South Africa the preservation of the forests is a question of vital importance.

Certain of the author's remarks on the distribution of vegetation show that he is fully alive to the truth first put forward, we believe, by Dean Herbert, that plants do not always grow by preference in the soils where we find them. On the contrary, a barren moorland serves often merely as a refuge where certain species retire from encroaching rivals, just as certain human tribes have fled to the deserts and the mountains as a refuge from invasion.

The Upper Flambeau region is exceedingly interesting from the evidences of glacial action which it presents. The accompanying map shows eight successive belts of moraine, lying in nearly parallel curves on a line proceeding from the north-east to the south-west. The small lakes and tarns are practically too numerous to be counted, and there are likewise a great number of "kettle knolls" or "knobs," sometimes 100 feet in height, and often occurring in the midst of marshes. Huge boulders are numerous, and may often, except carefully examined, be mistaken for rocks *in situ*. It is concluded that in this district there were three periods of glaciation, whilst the eight belts indicate as many minor periods included within the larger ones.

The entire volume before us proves fully that time and labour have not been spared in this geological survey, and that the work has been done in the spirit of thoroughness.

Where did Life Begin? A brief Enquiry as to the Probable Place of Beginning, and the Natural Courses of Migration therefrom, of the Flora and Fauna of the Earth. A Monograph. By G. HILTON SCRIBNER. New York: Charles Scribner's Sons.

THE author's hypothesis is substantially that at the very outset of geological time the earth's surface first became sufficiently cooled and consolidated to admit of the existence of animal and vegetable life at or near the North Pole, and that with progressing refrigeration the fauna and the flora were gradually driven down towards the tropics, becoming more and more differentiated the farther they receded from the place of their origin. This view, if not explicitly stated, is shadowed forth in Mr. J. A. Allen's system of animal geography, and is even, to a certain extent, implied in a remark by Mr. A. R. Wallace. The latter naturalist likens the existing continents to some huge tree, having its roots in the Arctic regions, filling great part of the torrid and temperate zones with its matted boughs, and sending out three out-shoots towards the South Pole. This similitude certainly suggests that the flora and the land fauna would correspond in their origin and migrations to the growth of their home.

The first question we have to ask is one which can only be solved by the physicists. Did the earth's crust really become first solidified at the poles? On this point we must confess ourselves unable to pronounce a valid opinion.

Perhaps, however, even the contrary view, *i.e.*, the simultaneous solidification of the earth's crust, would not be necessarily fatal to Mr. Scribner's hypothesis. We can easily conceive that under those circumstances the poles would be the coolest parts of the earth, whilst the intermediate regions were still too hot for animal or plant.

If the physical difficulties of the case can be got over, the evidence seems decidedly in favour of the author's view. The facts of animal geography seem in favour of migrations directed from north to south, rather than from east to west, or *vice versâ*. Within the Arctic circle the fauna shows comparatively little differentiation, so that Mr. J. A. Allen proposes in his classification one single Arctic region. Within the temperate zones the Palæarctic and Nearctic regions of Dr. Sclater and Mr. Wallace have still so much in common that Mr. Allen feels authorised to consider them as one primary region. As we go farther south the divergence increases. The fauna of Africa and South America are sharply contrasted.

Again, if we look at the palæontology of the case, we find evidence in high northern latitudes of a flora of temperate, or even subtropical, character,—proof of a climate very different from, and much superior to, that of lat. 55° to 60° at the present day.

The question here arises, why do the continents appear to begin at the North Pole in preference to the South? Has the bulk of the dry land always existed in the Northern Hemisphere and the bulk of the ocean in the Southern? Or have we here a case of alternate fluctuation, as suggested by Adhemer and others? We do not know that the compatibility or incompatibility of this hypothesis with the phenomena of organic distribution has ever been exhaustively studied.

The Mason College Magazine. Vol. II., No. 2. Birmingham: Cornish Bros.

We notice here a very important address on the "Progress of Chemistry," delivered by Prof. Tilden at the Inaugural Meeting. After a survey of the rise and progress of the science, and after noticing the modern pre-eminence of Germany in chemical research, the speaker asserted that "England is now in a fair way to retrieve her fallen fortunes. Abundance of good work is being done. . . . In the matter of instruction we are very little behind the Germans, and we are very rapidly gaining upon them." He then enumerates the college laboratories which have been erected and fitted up of late years. He continues:—"We have all these opportunities of teaching and learning chemistry, and yet we are not satisfied. What more do we want?" His reply is good as far as it goes, but imperfect, the main point being omitted. He answers:—"Among other things we want more money for material and appliances, more students, more leisure for the professors, more sympathy from the governing bodies in our work alike of teaching and research, more intelligent recognition of the usefulness of chemical knowledge by chemical manufacturers." But is this the sum-total of our deficiencies? Prof. Tilden himself shall supply the answer, though he fails fully to see it. He says:—"If we go into the iron- and steel-works of the North of England, into the dye-houses and print-works of Yorkshire and Lancashire, into the alkali-works of St. Helens and on the Tyne, we find the laboratories literally swarming with Germans, who are holding the situations which ought to be occupied by Englishmen. How long this state of things is to exist is a question which is entirely within the power of young English chemists to determine."

We have no need to point out what a fearful indictment the lecturer has here drawn up against the Science and Art Department. But we must ask ourselves whether it is within the power of young English chemists to render this invasion of aliens henceforth impracticable? To do this we must glance at the

systems of scientific and technical education which obtain respectively in England and in Germany. Our system is throughout examinational. The student is constantly preparing for some examination which he must necessarily "pass." The teacher—in all cases at least which come under the control of the Department—is paid by what are misnamed "results"; that is, by the number of his pupils who succeed in "passing." As long as this system prevails the English student and the English teacher are alike powerless.

The German system of science-teaching is totally different. A young man enters a university, and attends the class-room and laboratory of Professor M. or N. If he shows zeal, industry, and intelligence, the Professor, who keeps a watchful eye on every student, gives him some idea to work out experimentally, and assists him with advice and suggestions. When the investigation is completed it is sent for publication to one of the scientific journals, and the youth sees his name bracketted with that of a Hofmann, a Baeyer, a Kolbe, &c. More and more difficult problems are placed in his hands, and the assistance of the Professor is gradually withdrawn till he feels himself fully capable of original research, whether in speculative or applied chemistry. It is the interest of the Professor to detect, train, and bring out ability. The researches and discoveries made by his class are his "results." The more numerous and important such researches, the more students flock to his laboratory and his lectures. Rival universities contend for his services, and Government awards him public honours. Is it not plain as daylight that students thus trained must have more original, suggestive minds, and must be of more use in a chemical manufactory, than those whose great aim has been to pass examinations? To Prof. Tilden's question, "What more do we want?" the reply is simple. We want abrogation of "payment by results," and of the examinational system altogether. But to that system we cling

> "Like a torpid bat
> To a dead bough."

It is painful to hear eminent men complaining that in these days men study not to know, but to pass, and yet themselves take the "devil's arles" for upholding this delusion.

Mr. Evans read an interesting paper on "Feathers," and regretted the wanton slaughter of thousands of harmless birds at the dictates of fashion. Had we our will no *modiste* would dare to offer for sale the feathers of humming-birds, trogons, birds of Paradise, &c.

CORRESPONDENCE.

*** The Editor does not hold himself responsible for statements of facts or opinions expressed in Correspondence, or in Articles bearing the signature of their respective authors.

SIMSON'S "HISTORY OF THE GIPSIES."

THIS work, edited by me, was ready for the press in 1858, and was published in Great Britain and the United States towards the end of 1865. When submitted to the American press I find that it was accompanied by the following circular:—

"Herewith is respectfully submitted for criticism a copy of a 'History of the Gipsies,' just published, which, it is presumed, will prove, in some degree, a subject of interest, investigation, and discussion to the American people.

"The pivot on which the real interest in the Gipsies, during the past, the present, and the future, turns, is the phenomenon of the occasional amalgamation of other blood with theirs, their settlement, and the civilisation, perpetuity, and increase of the people, maintaining their identity in the world, notwithstanding their having no religion peculiar to themselves, like the Jews. The principle, or rather fact, here involved, is evidently very difficult of comprehension by the British mind, owing principally, it may be said, to its practical unfamiliarity with the idea of two distinct races living on the same soil, the extreme prejudice against the Gipsies, and the consequent singular incredulity towards anything good or sensible that may emanate from them as a race. In America the first-mentioned difficulty does not exist, while the distance from the location of the people principally described somewhat obviates the second and third.

"There is also a general difficulty to be overcome in the way of the present volume, in its more peculiar characteristics being allowed to pass current in the world,—and which seems to be inherent in human nature,—*viz.*, a disinclination to believe anything new on a subject which everyone imagines he knows, or which no one is presumed to know. In conducting an enquiry like the one mentioned, a simple regard to facts is the sole legitimate object of contemplation; it not being even necessary to understand *why* or *how* a phenomenon exists, to believe that it *does* exist. For example: no one professes to understand how it is that the Jews exist in their scattered state, yet no one denies, or even doubts, their existence on that account. In the present

volume, it may be said that the reasons given for the existence of the Gipsies in a civilised state are amply sufficient to explain, connect, and substantiate the various facts discovered.

"New York, 1866."

This should not prove without interest to a large part of English readers. It has been a matter of great surprise to me that in Great Britain there should have been, and should still be, such a strong aversion to examine, discuss, and do justice to this subject, which applies to a relatively large body of people whose blood for the most part is *not* Gipsy, but that of the ordinary one of the country. In "The Gipsies," as illustrated by John Bunyan, Mr. Carlyle, and others, published in 1883, I wrote as follows :—

"In my additions to the 'History of the Gipsies,' I think I presented every aspect in which the subject could be viewed. . . . I stated at great length on these occasions how the tribe acquired the names of the ordinary natives, how its blood got mixed, how it gradually swarmed from the tent and progressed, how it maintained its identity and will do so for the future, and what it is that in its essence constitutes a Gipsy, as distinguished from the nationality or family of other people" (p. 27).

JAMES SIMSON.

New York, March 25, 1884.

TECHNICAL EDUCATION.

I HAVE read with much interest the able articles on Technical Education contributed by Mr. Galloway to the "Journal of Science." The articles have opened up a subject of vital importance to Englishmen. The signs of the times unquestionably point to the decay of England's supremacy in the Arts and Commerce, and Mr. Henry George—no mean authority—has recently stated that, in his opinion, England has entered upon her period of decline.

The question arises, Why should England ever decline until her natural resources are exhausted? There is no reason, except it lies in the perversity of the official system which forces upon us inadequate methods of Technical Education which have for their only result a vast and useless expenditure of public money.

I have from time to time had ample opportunity of observing persons trained under the Science and Art Department, and I have been led to the conclusion that the training has been of little value in fitting them to take an intelligent part in commercial life, and I have been especially impressed by the almost

total want of originality of thought which such students have exhibited.

I trust that the articles will have the effect of calling the attention of independent educational reformers to the defects of our present system. It would be well if a Royal Commission, or some other form of inquiry, were instituted.

AN ENGLISH MANUFACTURER.

BESTIARIANS IN PARLIAMENT.

SURELY all medical practitioners, and scientific men generally, should see the importance of ousting Bestiarians from Parliament at the next election, and of using their best endeavours to prevent the return of any more of the fraternity. For such an object I submit that, for the time being, party considerations ought to be merged, and a solid vote given against the enemies of Science. It is rumoured that a Bestiarian will be nominated at Sheffield, and I trust that the profession in that town will leave no stone unturned to prevent his election.

A GRADUATE.

THE DEVOTION OF LOVE-BIRDS.

IT is commonly believed that if one of a pair of love-birds dies the survivor will mope and pine away. I have an instance to the contrary. Of a pair in my possession the female died about five weeks ago, after a very long illness. Her mate, however, instead of moping, seems as happy as the day is long, and does not seem in the least to miss his spouse.

E. S.

NOTES.

At a Meeting of the Liverpool Medical Institute Dr. Howie, as reported in the "Medical Press and Circular," discussed the influence which the present system of education has upon the health of the community. He held that it is the duty of medical men to insist upon the evil effects which are certain to follow if the present course is persistently pursued. Confining his remarks entirely to children under twelve, he said that no such child ought to be called upon to perform any kind of work, whether muscular or mental. That four hours *mental exercise* is enough, twelve hours in bed, four hours for meals, &c., and four for muscular exercise. That much as he believed in education as a means of national improvement, yet it would be better to have the masses uneducated than to train their minds at the expense of muscular strength and dexterity. Reading and writing, although extremely important, yet were not absolutely essential to the highest education; that facts themselves, without the ability to think and speak correctly about them, are of but small advantage in mental training. Under the existing educational code teachers are compelled to force into the minds of their pupils information for which they are utterly unprepared, either by age or by previous training. That the blame rests on the framers of this code who have utterly ignored the brain capacity of children, and not on the schoolmaster or inspector who are simply acting in accordance with their directions. Throughout the whole course of a child's school career most of the subjects of study are quite beyond his intelligent grasp, unless he is specially precocious. He then described at some length the influence which close confinement in school-rooms had upon the health, by inducing a tendency to frequent bronchial catarrhs, which in children of phthisical history will ultimately lead to that disease, and quoted several cases from his own experience in support of this. He also spoke strongly in favour of the half-day system of schooling. In our elementary schools it was not so much actual over-work as excessive stimulation of the growing brain which leads to its far too rapid growth to be healthy; the nerve structure is through this rendered extremely sensitive, and lacks stability. In order to remedy the present system he suggested that, first of all, we ought to choose good teachers, and give them a considerable amount of freedom in dealing with the pupils, and to abolish the system of payment by results. He therefore proposed that a Committee should be appointed by the Institution to inquire into

the question of over-strain in elementary education. This resolution was carried unanimously.

M. Cholodkovsky ("Comptes Rendus") has discovered that, in addition to certain Coccidæ as previously known, *Tineola biselliella* has only two Malpighian tubes. All other Lepidoptera have always six Malpighian tubes, and in general the anatomy of species of this order is more uniform than in the other orders. The caterpillar of this species has, like all other Lepidopterous larvæ, six Malpighian tubes. The researches of Rathke and Fritz Müller have sufficiently shown that a low number of these tubes is a primitive feature, and that with the progressive development of the organism during its metamorphosis the number of its tubes increases. In the Tinea we find the very contrary. It is probable that its remote ancestors had merely this number. We have, then, before us, a case of atavism quite exceptional in its character as occurring regularly. This *periodic atavism* seems to be a fact quite new to Science.

M. Dieulefait infers, from the presence of manganese in cipoline marbles, that both these marbles and the gneiss which encases them have been formed in water.

M. Minard has laid before the French Academy of Science a method for attenuating the violence of storms. He proposes to use a great number of lightning-rods, elevated on telegraphic posts and connected to the metals of railways.

Dr. H. C. Tweedy, in a paper read before the Public Health Section of the Academy of Medicine in Ireland, commits himself to the following utterance:—"Self-destruction is a crime in the eye of the law, and he who attempts it is *justly* liable to punishment." We deny the justice of punishing actions which interfere neither with the personal safety nor the property of the public.

MM. Soret and Sarasin ("Comptes Rendus"), on re-examining the absorption-spectrum of water, find in the orange a very faint and narrow dark band, a little less refrangible than the ray D, at about the fifth part of the interval between C and D, nearer D, and corresponding approximately to the wave-length 600.

The rejection of the motion for the Sunday opening of Museums was to be expected. Whilst recognising the feeble character of the arguments used against it, we cannot help noticing how much the question is complicated by the establishment of Museums in, or their transfer to, remote un-central localities, and by the opening in these institutions of "refreshment-rooms."

Mr. J. Gunn, F.G.S. ("Geological Magazine") contends that the changes of the climate, and of the Fauna and Flora, are most probably due to the alternate elevation and subsidence of mountain-ranges.

It is surely a sign of the times that a journal exists bearing the name of the "Competitor," and further styling itself "A Civil Service and University Examination Journal and Review." Even China can scarcely go so far!

The "Warrington Guardian" remarks that "the 'cramming' system is flourishing all over Britain undisturbed, and is working havoc among both the youth of the land and their teachers, who are succumbing to the mental strain put upon them at a most uncomfortable rate."

Dr. Landwehr ("Zeitschrift für Physiolog. Chemie") has succeeded in obtaining an animal gum, closely resembling the plant gums in its physical and chemical properties, and forming a new link between the animal and the vegetable kingdom.

We hear of a chemical manufactory, in Cheshire, in which not a single British subject is employed in any position of trust. What a commentary on our system of scientific and technical education, and on the "Department" by which it is administered!

Mr. E. A. Freeman, the historian, has made himself conspicuous at Oxford as a Bestiarian, and has shown his complete misconception of the very nature of Science.

A tornado which passed last month over Alabama, Georgia, and the Carolinas, killed outright over 300 persons in Georgia alone.

Dr. N. A. Randolph, in a paper on the digestion of infants, reprinted from the "Transactions of the College of Physicians of Philadelphia," and courteously forwarded to us, proves experimentally that many infants under three months can digest starch foods; that no broad and general statement can be made as to the period at which infants *begin* to digest starches; and that the physician can be absolutely certain that a farinaceous ingredient in the diet of a young infant is beneficial only by an analysis of the dejecta under such diet.

The International Geodetic Association has recommended the universal adoption of the meridian of Greenwich, reckoning longitude in one direction only, from west to east.

We have great pleasure in learning that the statue of Liebig has been completely freed from the stains by which it had been so shamefully disfigured. The spots consisted of silver nitrate and potassium permanganate. By treatment with ammonium sulphide these metals were converted into sulphides, and were finally removed by applications of potassium cyanide, the marble remaining uninjured. The perpetrator of the outrage has not yet been detected.

"Science" gives an instance of a prolonged drought in Virginia having been broken by the ascent of a column of hot air from the conflagration of about 40 acres of scrub pines. Rain began in little more than an hour from the origin of the fire, and continued till sunset. During the rest of the season showers occurred with ordinary frequency.

Mr. G. P. Sanderson, in a paper read before the Society of Arts, rates the intelligence of the elephant very much lower than is ordinarily done. He has only met with one instance of an Indian elephant which exceeded 10 feet in height, being 10 feet 7½ inches.

Prof. R. W. Raymond ("Kansas Rev. of Science") says, concerning the divining-rod, that in one department after another it has been found useless. If it be worthy the attention of scientific students, it is the students of Psychology and Biology, not of Geology and Hydroscopy, who can profitably consider it.

At the recent Hertford sewage trial the learned judge made the mistake of saying that the "Phosphate Sewage Company" had worked the "A B C process" there unsatisfactorily. We are authorised to say that the "A B C" sewage-process has never been worked at Hertford at all.

Dr. S. W. Burnett ("Science") refutes Mr. Lawson Tait's assertion that "no other animals than cats are affected with congenital deafness." He gives two instances of dogs, deaf from puppyhood,—one of them, moreover, not white, but yellow.

The average cloudiness in Kansas ("Kansas Rev. of Science") is 44 per cent, as against 31 in California, 47 in the Southern States, 53 in New England, and 71 in Great Britain.

Mr. E. F. Hardman, Government Geologist in Western Australia, reports what he regards as an instance of suicide by black snakes. A half-killed snake was attacked by black ants in the wounded parts, when "it instantly turned round and bit itself twice in the neck, with seeming determination." In less than one minute it was dead, poisoned, Mr. Hardman believes, by its own venom. His men reported this to be a common occurrence.

According to the researches of M. Certes ("Comptes Rendus") there appear to exist at the bottom of the sea ærobic microbia, but no anærobic forms.

Sir Richard Owen has described a mammalian species from the trias of South Africa. This animal, which has received the name *Tritylodon*, approaches nearer to the *Stereognathus* of the oolite than to any other form, but is still so distinct from all known animals as to throw no light on the ancestry of the Mammalia.

M. Ch. Richet shows that the hydrochloric acid of the gastric juice exists chiefly in combination with pepsine.

M. P. Reynard has communicated to the French Academy of Sciences some important experiments on the influence of great pressures upon various forms of animal and vegetable life. Beer-yeast, after exposure for one hour to a pressure of 1000 atmospheres, was not killed, and was afterwards able to set up fermentation in a solution of sugar. Algæ, after exposure for an hour to a pressure of 600 atmospheres, were still able to decompose carbonic acid in the sunlight. Infusoria were submitted to 600 atmospheres for half an hour: they appeared at first torpid, but rapidly recovered. Mollusks similarly treated recovered more slowly. Leeches at the same pressure appeared to be dead, but recovered in a few hours. With crustaceans, such as *Gammarus puba*, the phenomena were identical, but the recovery more rapid. Fishes without swim-bladder survived a pressure of 200 atmospheres, but perished at 300. These experiments illustrate the conditions of life at great depths in the sea.

The after-glow of the evening skies is described as having been splendid during the months of October and November, at Adelaide. Since then it has been gradually decreasing, but even on February 24th it was still visible as a fiery band on the horizon.

"Science" mentions a peculiar north wind felt in California, and which, whether hot or cold, "produces a feeling of great depression and nervous irritability, lassitude and restlessness." Its effects upon vegetation in summer are scorching.

Dr. Delaunay, in the journal of the Ethnographic Society, says that the civilisation of Europe has been retarded by influences from Asia. "Not to speak of cholera, plague, and other maladies, two-thirds of our intellectual lives are spent in perpetuating the errors and exploded fancies of Asiatic, Greek, and Roman mythmongers."

A deposit of gold has been discovered at Penaflor, in Andalusia.

M. J. Deniker ("Comptes Rendus") describes a fœtus of the gorilla in the fifth month of its life. In almost every respect it approaches closely to the form of the human fœtus at the same age. The hand differs from that of the adult gorilla by the greater proportionate length of the fingers. The leg is cylindrical, without the projection of the calf evident in the human fœtus. The cephalix index is 86·2.

According to M. G. Carlet ("Comptes Rendus") all the muscles of the abdomen of the bee, with the exception of those connected with the circulation, subserve respiration, and consequently the development of heat. By means of these muscles the abdomen can be expanded or contracted in all its three dimensions for the admission or expulsion of air by the stigmata.

M. Thollon, writing from the Nice Observatory to the Academy

of Sciences, states that, whilst prior to November last the sky had an intense blue tint up to the very margin of the solar disc, there now appears around the sun a dazzling white halo, of about 15° radius, slightly tinted with red outwardly and with blue inwardly.

M. Perrotin remarks that the general aspect of Uranus resembles that of Mars rather than that of Jupiter.

M. E. L. Trouvelot ("Comptes Rendus") considers that the so-called "polar spots" of Venus are the summits of lofty mountains which rise above the stratum of vapour enveloping the body of the planet.

Dr. Maercker maintains that cellulose is not truly digested by mammals. The portion which disappears during the digestive process is not assimilated, but converted into gases.

According to MM. Kellner and Imai the soil of Japan is by no means rich,—a conclusion founded both on chemical analysis and on the character of the prevailing vegetation.

A controversy on the "law of thermic substitution constants" is going on between Prof. Berthelot and Dr. Tommasi. On March 18th the latter chemist requested M. Bertrand, the Perpetual Secretary of the Academy of Sciences, to lay a certain memoir before the Academy. M. Bertrand remarked that, "as the discussion threatened to be prolonged, before deciding on inserting the memoir in the "Comptes Rendus" it would be well to submit it to some chemist belonging to the Academy. Having thus spoken he handed the paper to M. Berthelot (!), who was thus constituted judge in his own case. As a consequence, easy to be foreseen, the memoir has not appeared in the official journal. Such is official Science all the world over!

Metallic chrome is found to be, of all metals, the worst conductor of heat.

A pamphlet has just appeared at Leipzig which aims at proving that leaden service-pipes for water are free from danger.

The Hindus, we learn, regard the smallpox as a goddess whose visitations should not be in any way interfered with. Do some worthies at home entertain a similar reverence for smallpox, and still more for syphilis?

The Councils of the Entomological and—we believe—of the Linnean Societies find, to their regret, that they have no power to sign petitions in favour of Prof. Bryce's Bill without the step of calling a special general meeting for the purpose, which would come too late.

"Cosmos les Mondes" quotes a new German remedy for diphtheria (rectified oil of turpentine), and adds "let us beware of what comes from Germany."

The texture of sponges is said to become denser and finer the higher the latitude of their place of growth.

M. Boutigny, well known for his researches on the spheroidal state of liquids, died on March 17th, in his 86th year.

We learn that attempts are being made at Coblentz to use the raven as a substitute for the carrier-pigeon. It is less likely to be attacked by birds of prey, but it is much less plentiful, and does not, we believe, ordinarily breed in domestication.

A popular society for the study of Natural History is in course of formation at Warrington.

Miss F. M. Hele ("Science") has observed that the lemon-coloured variety of *Helix aspersa* is changed to a dirty brown by a diet of lettuce. The eggs of the modified specimens, however, produce only individuals of the normal colour.

Dr. J. M. Anders ("American Naturalist") demonstrates the exhalation of ozone from flowering plants, and thus furnishes a sanitary reason for their multiplication in cities.

According to Leonhard Stejneger ("Naturen") the skies of Kamtchatka are bright, the climate mild, and the flora luxuriant. The fauna is palæarctic, with a few nearctic forms.

Mr. W. D. Le Sueur has produced an able "Defence of Modern Thought," in reply to a lecture on "Agnosticism" lately delivered by the Bishop of Ontario. We may take occasion to examine Mr. Le Sueur's pamphlet.

According to the "Journal of Physiology" Prof. Goltz has conclusively shown the absence of localisation of function, in the ordinary sense of the term, for the brain of the dog, whilst Prof. Ferrier has failed to establish his theory of localisation of function for the brain of the monkey.

In the "American Naturalist" mention is made of Prof. Harrison Allen's palate-myograph, by which spoken language is represented by a series of curved lines on a surface of white paper coated with soot.

Referring to the condemnatory evidence of Mr. Mundella on the system pursued by the Science and Art Department (see our last number, p. 217), the "Freeman's Journal" remarks appropriately:—"The question very naturally arises why the right hon. gentleman has made no effort, now he has the power, to make a reform the imperative necessity for which he advocated when the power was in the hands of his political opponents?"

Dr. Paul Bert ("Comptes Rendus") concludes that milk-sugar is produced by the mammary excretion of the excess of sugar produced in the organism after parturition, and formed very probably in the liver.

M. Ch. Brongniart ("Comptes Rendus") describes the wing of a gigantic fossil neurorthopterous insect from the coal-beds of Commentry. The wing is 13 inches in length, and the insect must have been nearly 20 inches in length and 27 inches in spread of wing. The insect belongs to the extinct genus *Dictyoneura*, and is nearly allied to the Phasmidæ of the present day.

The complete success of the German Zoological Station at Naples, which has led to the foundation of similar institutions by England, France, and the United States, inspires the semi-official "Norddeutsche" with the following Chauvinistic reflections:—"The effect of the thunder of Sadowa and Sedan is manifest also in the leadership of scientific enterprises which German courage and self-confidence have conquered abroad."

According to W. H. Penning the High-level Coal-field of South Africa covers an area of 56,000 square miles.

Prof. Römer gives an interesting account of the Bone-caves of Ojcow, in Poland. A translation of his memoir is noticed in the "Geological Magazine." Bones of more than sixty species of vertebrate animals, extinct and recent, have been discovered. The specimens do not differ from those obtained from the Bone-caves of Moravia.

Prof. Zittel ("Geol. Mag.") maintains, after careful examination, that the hypothesis of a Quaternary sea over the Sahara is not supported either by the geological structure or the surface characters of the Desert. A moist climate prevailed in North Africa during the Quaternary period.

We learn that at a meeting held in the rooms of the Royal Society it was resolved—"That in the opinion of this meeting there is an urgent want of one or more laboratories on the British coasts, similar to those existing in France, Austria, Italy, and America, where accurate researches may be carried on leading to the improvement of zoological and botanical science, and to an increase in our knowledge as regards the food, life, conditions, and habits of British food-fishes, and mollusks in particular, and the animal and vegetable resources of the sea in general." Prof. Ray Lankester is Secretary to the Provisional Council appointed to carry out the objects of the meeting.

[Should not one such laboratory be placed in Guernsey or Jersey?]

Clulau -/6
6.5.84.

TWENTY-FIRST YEAR OF PUBLICATION.

THE

JOURNAL OF SCIENCE,

AND ANNALS OF

ASTRONOMY, BIOLOGY, GEOLOGY, INDUSTRIAL ARTS, MANUFACTURES, AND TECHNOLOGY.

(MONTHLY, FORMERLY "THE QUARTERLY JOURNAL OF SCIENCE.")

POST TENEBRAS LUX

Vol. VI. (Third Series)
No. CXXVI.

JUNE 1884.

CONTENTS.

LONDON:
2, HORSE-SHOE COURT, LUDGATE HILL.

Where Communications for the Editor and Books for Review may be addressed.

PRICE ONE SHILLING AND SIXPENCE.

THE

JOURNAL OF SCIENCE.

JUNE, 1884.

I. WHAT IS RELIGION? HYLO-IDEALISM?

By S. BILLING.

A PAMPHLET with the above title, by C. N., annotated by Dr. Lewins, with Appendices, is intended more or less to exemplify Hylo-Idealism, which he assumes should take the place of all other religious philosophies. Several notices on the subject appeared in the "Journal of Science," difficult to understand because, unconnected, they conveyed the impression (to my mind) of an ill-digested Materialistic propaganda. By advertisement it appears the subject is collected and presented as a whole, by C. N. and Capt. McTaggart, aided by a critique of the latter work in the March number of this Journal. The critique by your reviewer excited my attention, and induced me to read the pamphlet. The reviewer, with his usual kindness, has conveyed a favourable impression of the work; but it appears to me he has either been biassed in his judgment, in his desire to say pleasant things, or he is wanting in that logical discernment so necessary to be employed on subjects of this class. I fail to find in this review that comprehensive grasp and powerful acumen which are so ably exhibited when the examination of works on Biology, Chemistry, and other subjects of *pure* Science are the questions in comment.

The time was when some learning was required to write even a comment upon received opinion, but this is all reversed; flippant observations now have the place once occupied by research and learned lucubrations, bald assumptions are paraded as results, and great names spice the

production. Imagination in lieu of learning becomes the basis of the arguments, and such authors (as did George Sands, but without her powers) proclaim the necessity of a New Messiah, wherein moral obligation and duty based on religious sentiments are to be erased from the mind. Comte tried this system, when his philosophy was found inadequate to satisfy humanitarian needs; even his followers confess the mess he made of it. This positive science is frequently quoted, and has found able defenders, but none of them advocate the "*Nouveau Grand-Etre Suprême.*" "A gigantic fetish, turned out bran-new by M. Comte's own hands, reigned" instead of the displaced Dieu. Who, in the now day are they who come forward to explain the mystery and gaze unblinking into the depths of the light, and measure the immeasurable vastness to a hair?" "They step down to the people with stately step and voice of authority, and deliver their twopenny tablets as if there was some Divine authority for the wretched nonsense recorded there." What does all this philosophical "friskiness" lead to? Their professors are so wonderfully sagacious that they flounder at every step; so clear-sighted that they cannot see existing things; their "extinguishing" genius would "put out every light sufficient for the conduct of common men." Oh! men of genius never take heed of duty; it is the manacles of slaves, and when you have grown sick of your liberty assert license, and scoff at the morals and religions of men who possess them. What are their feelings and opinions? Take refuge in your philosophy; never mind whether it has consonance, intelligibility, or logic; stick to it as Diogenes did to his tub; if it answers no other purpose it will at least show that you have a pride in your opinions. Take no heed how often they have been refuted, or how stale the propositions; never heed that they are nonsense, so that some scheme is preached which shall end in annihilation or in a rehabilitation in some material phenomenon.

The key-note of the new philosophy is "that man is the measure of the universe." We are further told "that man sees himself mirrored in Nature,"—what may this mean?—and "no man has defined the ultimate limits of Nature." Perhaps there are some far depths only discoverable by the Hylo-Idealists: its Messiah steps in to aid with a note, "Man knows and feels that Nature is mirrored in himself, being the image of his Ego, and not *vice versâ.*" The Ego may be the result of natural facts, but then certainly not isolated. Where in Nature—that is, in phenomena—are we to discover

this intellectual image? It is apprehended that we must go beneath phenomena to find this intelligence.

Perhaps a word of advice from the learned, gentle, and devout philosopher Schleiermacher may be opportune. He says—"Beware of the writings of authors who reveal the petty, selfish, intolerant spirit . . . in their endeavours to spread their own fame and force their systems on others under the pretence of enlightenment." "The truly wise, the further they penetrate in their investigations of truth, the more modest they become and the more distrustful of themselves,—ever alive to inward deceit and prejudice, which blinds the understanding, regardless of that noble freedom of thought which submits to no law but that of truth."—("Life," vol. i., p. 76.)

No man has a greater respect for ratiocination and freedom of opinion than I have, but at the same time I do not think that undigested comments should be obtruded in such a manner as to be an insult to the opinions of others. The most harsh and disagreeable conclusions can be forcibly presented without that obtrusive impertinence so generally adopted by would-be philosophers. We have a specimen of this mode in the pamphlet in question, together with its very stale appendices. C. A.'s letter in the April number of this Journal is also an apt specimen of the style adopted. She were better employed in woman's vocation—as Iago suggests, "suckle fools, &c."—than so to write. C. A., however flimsy the mask, has torn it from the Hylo-Idealism theorems, and says that the protoplastic substance paraded as a cause is pure Monism. The religious feeling, and happy are they who have it, however illogical may be their conclusions, their opinions are at least entitled to respect, and should not be subjected to the ribald rubbish with which C. A.'s letter concludes. An argument advanced or a discussion is quite permissible, but it should be an argument, not a sneer. It is more than probable the Athanasian Creed is more capable of defence than this Hylo-Idealism; an analogous proposition can be found in the triune idea—Matter, Life, and Intelligence—as constituting unity, the Ego; each incomprehensible, for no finite apprehension has hitherto solved their origin. So equally incomprehensible is the philosophical theses, to be and not to be,—*i.e.*, being and not being, at one and the same instant. We could go through philosophies and find propositions equally extravagant. If C. A. were endowed with the wonderful lore that she and her fellows ascribe to themselves, it is surprising that she advances arguments so feeble, and at the same

time conceived in such bad taste. Whatever be the teaching of the Athanasian Creed it is much better than that she advances, the fundamental principle of which is the self. A few individuals probably would reserve to themselves propriety of conduct, but as the common creed of man it would be subversive of all morals and order, and would loose the most degrading despotism, and make the most disgusting license the rule and practice.

Prof. Huxley tells us that Science is "trained common sense,—*i.e.*, the experiences of man verified by observation. If this axiom is applied to Hylo-Idealism, where are we? All intellectual aspirations and moral obligation ignored, nothing left but the individual self,—"thinks,"—the inspirations of phenomenal images,—we can then, having our origin in matter, but think matter. "It was the dogma of the Sophist that man is the measure of all things; it should not be the dogma of the sober thinker" (H. G. Lewes). What says the great Idealist, Berkeley, who teaches there is only one substance, *viz.*, Spirit, and with this he can "construct the world." "Of the existence of matter we have no proof whatever; it is a mere inference: it is inferred in order to explain phenomena, and what phenomena? Those of perception—*i.e.*, the phenomena of the thinking substance." Hume said Berkeley's hypothesis admitted of no answer, but produced no conviction. H. G. Lewes says—"and we have met with no final refutation of it." "That the theory is opposed to the irresistible belief of man is no refutation of it, because it does not follow that irresistible belief is true,—*e.g.*, for many ages it was believed that the sun revolved around the earth; the belief was irresistible, and false." So now that the sun rises and sets, when the sun is said to set the earth revolves from west to east, and so obscures the sun; also when it is said to rise it is the revolution of the earth which makes it apparent. It is a continuation of the old belief, and has correction in Science. Kant said "Admitting Idealism to be as dangerous as it really is, it would still remain a shame to philosophy and reason to be forced to ground the existence of an external world on the (mere) existence of a belief."—(*Vide* "Biog. Hist. Phil.," p. 274, *et inf.*) In all matters of belief the true question is, Is the belief well founded? If Lewes, Hume, Kant, and a host of reasoners are in opposition, What is the answer of the Hylo-Idealists? That man is the measure of all things; that thinks are things; that there is but the Ego—hence that all knowledge is individual. Further on we shall see C. N.'s exposition. The great error

in all these discussions arises, as it appears to me, is the maintaining that there are *states* of consciousness. *We are conscious or we are not conscious.* Consciousness is indivisible: there are states of mind, of thought, of intelligence, of sensation; and unless mind, thought, intelligence, and sensation—which are each individual and distinct—mean consciousness, there can be no states of consciousness. Consciousness defines and represents the action of a something which it makes apparent as an effect or a cause, as the case may be. Man is made up of inorganic compounds energised by vital power, intelligence, sensation, and animal instincts, by the combination of which he has the consciousness of external phenomena; he cognizes not only his own thought, the self, but the non-self also,—*i.e.*, the Ego and the non-Ego: this is the practical illustration arising from the fusion of intelligence, sensation, and animal instincts, whatever metaphysical idealism and materialistic assumptions may assert to the contrary. The external world is as much a part of man as his own Egoism, and this makes human life and human aspirations possible on the humanitarian principle of communion with his fellows, whereby a common characteristic intrudes into phenomenal observance, and makes man one in the unity of consciousness. Nature is the general bond and the general instructor. The consciousness grasps phenomena, and man's intelligence informs him of their meaning and use. In the analyses of phenomena man gets behind and within, and the enquiry is then as to causes. This is no question of "thinks" (imaginations), but a question of things conducted by a process of analytical dissection, observation, and experiment, ending in an intellectual synthesis which informs the mind: this is the only process by which Science is made possible. By this method of investigation, however, the solid phenomena vanish, we are landed in gases, and a something even beyond them: by this system we arrive at gases in layers only held in their places by the gravitation of their particles, the true equivalent of which is weight; and thus, by reason of their inertia, they would ever remain but for an external something of which even the Materialist admits the necessity. All the grand processions of phenomena vanish, and there remains, so far as perception is concerned, an indistinguishable mass, without form, without impulse, without sensation. Perforce then we fall back on the origin of formation,—*i.e.*, intelligence, or its grander and truer name, the first cause. To argue that intellect is the result of gases in strata (leaving out altogether the hypothesis of the fire

miest, for that, if it ever occurred, was a something in advance), thereby utterly forsaking the grand panacea common sense, which itself is a product of intellect emancipated from the thralls of philosophies through observation and experiment; it is much more reasonable to suppose that matter had its origin, or at the least derived its formative power, from intellect, than that intellect had its origin in matter. When we talk of material phenomena we in reality talk of intellectual manipulation,—*i.e.*, intellect embodied in the phenomenal display. If arrangement in the arts is due to intelligence, by a parity of reasoning we are compelled to admit that natural phenomena is the product of intellect, and of an intellect so powerful in its grasp that it compels homogeneity and unity,—for we must remember the scientific axiom that "the unknown is to be interpreted by the known." Is it now possible to say that intellect originated from matter, which at its best is but a plastic substance dominated by intellect which wills and executes? Matter does neither; inert until vivified by intelligence. When the Materialist bases his creed upon matter he ignores himself, forgetting that force is an impulsion not born of itself, but becomes active by an antecedent impulse. An effect embodied in its antecedent effect becomes a cause; so an effect becomes the cause of a succeeding effect, rolling in a grand sequence resulting in orderly arrangement; this is progression in its real meaning,—the evolution of effects bound up in their antecedent causes; the universe of effects resulting from the primal cause, mayhap Aristotle's unmoving centre.

All this appears to me the commonest of surface reasoning; cause and effect as impulsed by intelligence, and so maintained in homogeneity. Go back as we may, it is but to find a ruler and a maintainer. We may talk of matter and force, but after all we are never rid of "the pusher and the puller"—vital intelligence. Call it what we may—"protoplastic" if you please—that which embodies, fashions, and maintains is the Creator, and in psychological existence we find a grander name, a more potent existence, unfolding the cause of the origin of all phenomena. When the Materialist talks of Nature, does he set bounds to Nature? does he know the all of Nature? Who shall prescribe its limits? The material and the psychological are unity as we know it—within, surrounding and without material phenomena. There is an occult something existing in the very womb of Nature—we know and feel it to be there, although we cannot penetrate to it—which no finite ideas can grasp, and its

realisation in human intelligence is by abstract reasonings. If we summon the beliefs of man as an evidence, the evidence is most conclusive, for never has there been a people found who have not this abstraction,—presented as creeds, cults, superstitions, worship of dead ancestors, &c., all pointing to the belief of a life beyond the earth life. If, then, there be a life beyond the grave—and of this I have no doubt, Science leads to such a conclusion—it is clear there must be a link with the unknown, and there is to be found the Interpreter and the Law-giver. Is it because man has discovered the method of some of the mechanics and chemistry by which Nature produces her results, that therefore he comprehends the all of Nature, its origin, and end bounding the Universe, by his own narrow perceptions? The very fact of his limitation and cognition shows that intelligence is a working principle, for without intelligent consciousness where were all his theories? Himself in his "*thinks*" omnipotent and a God—pshaw! Carry back his histological learning a few centuries, what did he know of the kingdoms of the Infusoria, which play so great a part in the economy of Nature? "Life swarms everywhere, life preys on life; whence is this inexhaustible flood of existence, from the atom fluttering in the sunbeam up to the star lost in the depths of infinity? what principle can we discover to explain this limitless, eternal, and boundless prodigality?" A principle of being there must be. What did we know of the order of the systems of worlds and luminaries, of suns in strata, in myriads. If these grand additions to scientific knowledge are the results of few centuries, what may we not hope for with the improved scientific appliances and methods of culture in the coming eras of existence? We may know even the unknown, and discern what we now conceive to be an unembodied reality. To limit thought, mind, soul, and the all of the great unknown to an origination from matter is ignoring the very being of man. Step by step, from the protamœba to the human, man has ascended organically and intellectually, until he has become a thinking, intellectual, conscientious, and moral being. To what end? To perish utterly? To become dust, to pursue the same round commencing again where he began? It is an illogical sequence. If progress and development and evolution mean anything, it (if they are one) means the attainment of a higher phase than that of perception, or even of human conception; the intellect must expand and obey the law until the illimitable is reached,—possibly a resolvement into its origin, as Buddha taught. It is in the unknown we can know the why and the

wherefore. We cannot resolve the Infinite: the ancients were wiser than we; they accepted benefits, and thanked the Gods. The inscription on the Temple of Isis was a check to man's presumption:—"I am what I am: none have ever penetrated the mystery which surrounds me; none ever will penetrate it."

And with Thackeray say "I would rather live in a wilderness of monkeys, and listen to their chatter, than in a company of men who deny everything."

If C. N. wishes to stand forth to the world as the expounder of a new philosophy, a drastic reforming of the world's ideas, as he assumes, why does he not give his name in full? Surely he is not so modest as to "hide his light under a bushel"?—a small tin pot would be a nearer ideal. It is too much the custom of those gentlemen who pretend to know more than their fellows; and when they, as they suppose, lead an onslaught into those regions which thinking men deem sacred, shelter themselves under an initial or a *nom de guerre*,—as Saladin, Julian, &c.,—who send forth pæans *in excelso*, and join in a chorus of adulation each of the others' extreme ability, and in imagination join in the shout—Behold the lights of the intellectual world. And what is the upshot of these rhapsodies? a recapitulation of very stale metaphysics, old philosophies, and rank Materialism: their inspiration appears to be Dr. Buchner, and the low school of German thought; Dr. Lewins, the Messiah of the movement, adopts the old sophist Protagoras. From this category it is fair to except Captain McTaggart, who has really presented a very masterly attempt to defend a really indefensible position; he has said much in correction of the uttered absurdities, and yet ends in a most illogical manner, *viz.*, in the acceptance of this very crude assumption, Hylo-Idealism, of which neither of its parts, Materialism and Idealism, are pursued to their logical conclusions. McTaggart, McTaggart, you are capable of something better than this. Prof. St. George Mivart's work, "Nature and Thought," in its first three divisions,—"The Inner World," "The Outer World," "The Intellectual World,"—has anticipated all the Hylo-Idealistic theories, and has refuted them. All the arguments adduced in support of the theory in that work meet their answer. It is a work I should recommend for the perusal of Dr. Lewins and his enthusiastic proselytes. If Capt. McTaggart has not met with the work, he will find in it a congenial study; if he has met with it, then I am utterly at a loss to account for the conclusions he has arrived at. Its last division "Causes and

Consequences," leads to an advanced thought: it is too hopeful an idea to suppose that these large talkers could grasp it.

I have thought it well to parade the opinions of the Sophists on which this doctrine of Egos, non-Egos, and "thinks" are founded, and set forth some opinions of Berkeley, the great Idealist, and his commentators. Unfortunately, although the Hylo-Idealists claim Idealism it is not the Idealism of Berkeley, who centres the whole of his assumptions in the consciousness of God.

As to Protogoras, who is assumed to be the base of the pillar, what was his teaching? Protagoras of Abdera (480 B.C.) His saying "that man is the measure of the Universe" contains the marrow of the philosophy of the Sophists,—*i. e.*, "that our *individual* judgments and feelings were the standards of the true and the false, of the right and the wrong; that whatever each man regarded as right was right, and that whatever he regarded as true was true," which doctrine, Dr. Ferrier rightly says, "obviously unsettles the foundations both of truth and of morality, and opens a wide door to every form of ignorance and licentiousness." The ultimate assumption of the Sophists was "that sensation is the essential attribute of man." This assumption was grappled with and overthrown by Socrates and Plato, who showed that thought (something essentially different from sensation) is the fundamental attribute of man, by showing that ideas were the common property of all intelligence, whilst sensation is limited and particular, and thus they asserted that man is competent to the attainment of that which is absolutely and universally true; they admitted that man is "the measure of the Universe" in so far as he is a thinking, but not in so far as he is a sensational, being.

G. H. Lewes ("Biographical History of Philosophy") says, let us suppose that Protagoras accepted the doctrine of Democritus excepting "*the atomic and reflective:* these two imply each other; reflection is necessary for the idea of atoms; and it is from the idea of atoms, not perceived by the sense, that the existence of reflection is proved." "He said thought was sensation, and all knowledge consequently individual." Lewes seems to suppose that Protagoras derived his doctrine from Heraclitus, who maintained "the doctrine of thought being identical with and limited by sensation. Now this doctrine implies that everything is true *relatively,*—every sensation is a true sensation, and, as there is nothing but sensation, knowledge is evidently

fleeting and imperfect." In such a mind as that of Heraclitus "such a doctrine would deepen sadness, till it produced despair." With Protagoras the formula was "Man is the measure of all things."

Sextus Empiricus.—"Matter, says Protagoras, is in a perpetual flux whilst it undergoes augmentations and losses; the senses also are modified according to the age and disposition of the body; that the reasons of all phenomena (appearances) resided in matter as *substrata*, so that matter, in itself, might be whatever it appeared to teach. . . . . Whoever is in a healthy state perceives things such as they appear to all others in a healthy state, and *vice versâ*. A similar course holds to different ages, as well as in sleeping and awaking. Man is therefore the criterion of that which exists; all that is perceived by him exists; that which is perceived by no man does not exist."

"The Sceptics were content with the conviction of the insufficiency of knowledge; the Sophists had the vanity and desire to penetrate the mysteries of the Universe. In their visits to various cities they found varieties of laws and ordinances, and this convinced them that there were no such things as right and wrong by nature, but only by convention. This because of their corollary of their dogma respecting truth. For man there was no eternal right, because there was no eternal truth. This denial of abstract truth and abstract justice is easily pushed to absurd and immoral consequences."

The Sophists were the natural production of the opinions of the epoch, and in them is seen the first energetic protest against the possibility of metaphysical science. It was the protest of baffled minds. The scepticism of the Sophists was a scepticism with which no great speculative intellect could be contented (*vide* pp. 98 to 103 inclusive).

Tennemann's notice of Protagoras is as follows:—"He maintained that human knowledge consists only in the perception of the appearance through the subject, and that whatever appeared to any one in his state at the time was true; consequently that man is the standard of all things; that, as far as truth or falsehood are concerned, there is no difference between our perceptions of external objects; that every way of considering a thing has its opposite, and that there is as much truth on one side as on the other; and that, consequently, nothing can be supported in argument with certainty; maintaining at the same time the sophistical profession to make the worse the better argument."

He doubted the existence of the Gods.* Yet he must have believed in the Gods, or why would he be content to take such remuneration for his teaching as his pupil was willing to pay, only requiring him to go into a temple and make oath that it was his sincere belief that the sum was sufficient (*vide* Grote's "History of Greece," vol. vii., p. 45).

Grote, speaking of this philosopher, says—"He taught that man is the measure of all things, both of that which exists and of that which does not exist—a doctrine canvassed and controverted by Plato, who represents that Protagoras assumed knowledge to consist in sensation, and considered the sensations of each individual man to be, to him, the canon and measure of truth."

The only author I have met with who seems inclined to defend Protagoras is Grote, but he was the general defender of the Sophists. He says—"In so far as we can understand the theory, it certainly was no more incorrect than several others then afloat from the Eleatic school and other philosophers, whilst it had the merit of bringing into forcible relief the essentially relative nature of cognition,—relative not indeed to the sensitive faculty, but to that reinforced and guided by the other faculties of man, memorial and ratiocinative; and had it been more incorrect than it really is, there would be no warrant for those imputations which modern authors build upon it against the morality of Protagoras. No such imputations are countenanced in the discussion which Plato devotes to the doctrine: indeed if the vindication he sets forth against himself, on behalf of Protagoras, be really ascribable to that Sophist, it would give an exaggerated importance to the distinction between good and evil, into which the distinction between truth and falsehood is considered by the Platonic Protagoras as resolvable. The subsequent theories of Plato and Aristotle respecting cognition were much more systematic and elaborate, the work of men greatly superior in speculative genius to Protagoras; but they would not have been what they were had not Protagoras, as well as others, gone before them with suggestions more partial and imperfect."—(*Id.*, vol. vii., pp. 50, 51). Aristotle, discussing the doctrine of Protagoras, says "that this doctrine comes to no more than saying that man, so far as he is cognizant or so far as precipient, is the measure of all things; in other words, that knowledge or

* "Respecting the Gods I neither know whether they exist nor what are their attributes; the uncertainty of the subject, the shortness of human life, and many other causes debar me from this knowledge."—Grote's *History of Greece*, vol. vii., p. 48.

perception is the measure of all things. This, he says, is trivial and of no value, though it sounds like something of importance."—(*In notis, Ibid.*)

Gorgias, a contemporary of Protagoras, wrote a treatise on Nature, or that which is not. He says, "Firstly, that nothing exists; secondly, if anything exists it cannot be known; and thirdly, if anything exists and can be known the knowledge cannot be imparted." Tennemann's exposition of Gorgias is, first, that nothing real exists, because neither negative nor positive; nor both at the same time can really exist; but even granting that something real did exist, yet, *second*, it would not be cognisable, because if thoughts are not real things the real cannot be thought; and if thoughts were real things that which is not real could not be thought; consequently everything thought must be real in that case. Finally, even if something were cognisable, it could not be imparted by the medium of words, because words do not express things, and nobody thinks like his neighbour." Grote says the teaching was "that nothing exists; that if anything exists it is unknowable; and granting it even to exist, and to be knowable by any one man, he could never communicate it to others." Grote observes that the modern historians of Philosophy denounce the scepticism of the Sophist, "instead of explaining his thesis in immediate sequence with the speculations which preceded it." "In our sense of the words it is a monstrous paradox." "The word existence as they understood it (the Eleatic philosophers), did not mean phenomenal, but ultra-phenomenal, existence. They looked upon the phenomena of sense as alway coming and going,—as something essentially transitory, fluctuating, incapable of being surely known, and furnishing at best only grounds for conjecture. They searched by cogitation for what they presumed to be, the really existing something or substance—the noumenon, to use a Kantian phrase—lying behind or under the phenomena, which noumenon they recognised as the only appropriate objects of knowledge; they discussed much whether it was one or many." This probably is the protoplastic substance of the Hylo-Idealists. "The thesis of Gorgias related to this ultra-phenomenal existence, and bore closely upon the arguments of Zeno and Melissus." "Protagoras and Gorgias found predecessors indeed, but no binding precedents to copy, so that each struck out more or less a road of their own." "We do not know how far Gorgias agreed in the opinion of Protagoras, that man is the measure of all things."—(Grote, *Ibid.*)

G. H. Lewes says—"The Sophistical art may have been essentially corrupting, although to contemporaries it did not appear so. We believe it was so, if it is to be made responsible for all the consequences which can be logically deduced from it. But logical consequences are unjust standards. Men are not responsible for what others may consider their doctrines lead to."

G. H. Lewes's opinions appear to have excited the reverence of the Hylo-Idealists: a philosophy they term it. His concluding remarks in his "Biographical History of Philosophy" suggest the impossibility of philosophy: he says, "If any one remains unconvinced by the accumulated proofs this history affords of the impossibility of philosophy, let him distinctly bear in mind that the first problem he has to solve is—Have we ideas independent of experience?" (I unhesitatingly answer, Yes. Our ideas of God are not the results of experience. We adduce them from the homogeneity of Nature, based on the scientific axiom that the known must interpret the unknown.) "Look at the state of philosophy: there is no one system universally accepted; there are as many philosophies as there are speculative notions,—almost as many as there are professors." The opposition between Religion and Philosophy is "inevitable; it lies in the very nature of philosophy; and although now, as heretofore, many professors eagerly argue that the two are perfectly compatible and accordant, the discordance is, and always must be, apparent." The evil of the speciality of scientific men, or their incapacity, is not confined to the neglecting the whole for the sake of the parts; it affects the very highest conditions of Science, namely, its capacity of instructing and directing society. So we have general ideas and positive science: the general ideas are powerless, because they are not positive; the positive sciences are powerless, because they are not general." Lewes says, so far as regards philosophy, we in the nineteenth century are precisely in the same position as we were in the fifth,

Speaking of Idealism, on the discussion of Berkeley's Idealism, Lewes says, "In admitting all this, what do we admit? Simply that human knowledge is *not* the measure of all things. Objects *to us* can never be more than ideas; but are *we* the final measure of all existence? It was the dogma of the Sophist that man is the measure of all things; it should not be the dogma of the sober thinker. Because we can only know objects as ideas, is it a proper conclusion that objects only exist as ideas? For this conclusion to be rigorous we must have some proof of our knowledge being

the absolute standard of truth instead of the standard of the relation things bear to our intellect." He says he admits, with the Idealist, that all our knowledge of objects consists in ideas." . . . But not "that all existence is limited by our knowledge merely on the ground that where we could conceive anything existing we are forced to conceive it in accordance with the laws of our conceptive faculties." So also "that all our knowledge is subjective," but not "what is true subjectively is true objectively." So also "in the existence of an external world quite independent of any precipient,—not because such is the obvious and universal belief, but because the arguments by which Idealism would controvert it are vitiated by the assumption of knowledge being the criterion of all existences,—Idealism agrees with Realism in placing reliance on the evidence of sense; it argues, however, that inasmuch as our knowledge is confined to ideas, we have no right to assume anything beyond ideas. Yet it is also forced to assume something as the cause of ideas; this cause it calls the will of the Creator." This Lewes says is an assumption. It may be so; yet all systems have some principle, however they may disguise it. Even in the materialistic theory Lucretius was forced, by the necessity of reason, to adopt volition, "seeing that atoms left to their own action could never cohere, and would remain for ever inert." So he said of the Earth, "she being impregnated produces." This fecundating principle he terms the ether. So, whether it be Materialists or Hylo-Idealists, there is always a something intervening other than the fundamental principle of the system. Idealism logically ends in spirit; Materialism in gross substance. Lewes says that Spinoza taught that there was but one essence in the universe, and that one was substance. Berkeley also taught that there was but one, and that one was thought. Now call this one what you will, the result is the same, speculatively or practically. You may have certain degrading associations attached to the idea of substance, or certain exalted associations attached to that of spirit. But what difference can your associations make with respect to the real nature of things."

Above is presented all that can be said of the philosophies, *viz.*, those of Protagoras and Gorgias, on which is founded the system in discussion, together with G. H. Lewes's remarks, showing his ideas generally on the subject.

(To be continued.)

II. ON ELECTRICITY AND ITS PRESENT APPLICATIONS.*

By W. Fraser, A.M., M.R.C.S. Eng.

It is right to mention that this paper—or rather the nucleus of it—has been already read to a Medical Society and to an Ecclesiastical Guild, a statement you will readily believe from some passages in it—*entrées*, I may say, in the entertainment—specially provided for the tastes of these guests. But now that I have ventured, though with fear and misgiving, to bring it before an audience of philosophers, who are quite competent to deal with the subject, I have added a few *pieces de resistance*, which may help to secure your attention, and afford something to eat up and masticate, whether you think fit to swallow and assimilate them or not.

An apology may be expected for my bringing before a Medical Society a subject not strictly medical, and I quite admit the validity of the objection. But although electricity has never been so far professionally recognised as to have a place in the Pharmacopœia, we all know that it has long been employed both as a diagnostic and therapeutic agent, and that of late it has proved a valuable method of treatment (particularly in nervous diseases) in the hands of several eminent London physicians.

We know, too, that in the present period of popular excitement it is beginning to take a prominent place in the field of quackery, with plausible and high-sounding pretensions, and in such a way as will probably prove an obstacle to its employment in legitimate medicine. I do not think, however, that legitimate medicine will suffer much by the loss, for whatsoever may be the influence that Electricity has in regard to the functions of the human body,—and it is undoubtedly great,—this influence or these influences can best be brought into action through the judicious use of the old and ordinary means, whether pharmaceutic or psychologic,—acting as these do, through the nervous or electric functions of the body itself,—which the profession has long been accustomed to employ.

* Read at the Aberdeen Philosophical Society, February 5th, 1884.

I do not, therefore, intend to treat the subject specially in its medical aspect, and shall, without further apology, bring it before you in the way that has happened to approve itself to me. You will not, I hope, take offence if I ask you, during the reading of the paper, to fancy yourselves in the position of a group of children, or of untutored natives of the East listening to one of their own story tellers, while he tries to please them for an hour, and to convey to them some practical and useful instruction by the scenes and sketches he places before their imagination.

When the Allwise, Omnipotent, and Eternal created and organised this world, he placed in it certain Genii, immortal but soulless spirits,—His slaves or ministers, as they might be called,—to carry out His will in its government, and in the purposes He had in view in its creation. One of the most powerful of these—the Genie of the mystic fire, Electron—is invisible to the human eye, and unrecognisable by the ordinary human senses, except upon rare occasions, or when subjected to the spell of a skilled magician.

It is difficult to give a correct portraiture and dimensions of this great spirit; but it may be said that, while his head reaches far above the clouds, and his feet go down into the bowels of the earth, and traverse them more freely than a bird can fly through the air, he can also enter into the smallest and invisible cell that forms part of the material of the globe. In truth he performs an important part in almost all the operations going on in the world, whether great or small; but so quietly and gently does he work that his presence is never known or suspected, except on the occurrence of something calculated to rouse him to anger or opposition.

The power and immensity of this Genie may be in some degree comprehended when it is stated that the tremendous roar of his voice, the dazzling brightness of the flash of his eye, the inconceivable rapidity of his movements, and the irresistible force of his strength are such that in respect to them there is no terrestrial being that can be compared with him. When careering with his full force, if any obstacle should interrupt his progress or tend to circumscribe his liberty, he will in a moment burst the strongest barriers in his way, shattering and destroying them by streams of fire which he launches forth, accompanied with such appalling and tremendous bellowings as seem to make the earth to tremble. Such behaviour on his part naturally inspires mankind with terror and awe, and it has had the effect, in past times, of deterring them from cultivating his

acquaintance or friendship. Indeed, until very recent times, they looked upon him more in the light of God's minister of punishment and destruction than as the friendly and beneficent, though powerful, being they are now beginning to discover him to be.

A wise man of America, named Benjamin, who, more than a hundred years ago, was among the first who had the courage, sagacity, and tact to enter into close and friendly relations with him, by a careful study of his character and habits, succeeded in making an arrangement by which—in consideration of an easy and free passage being provided for him between his favourite resting-place under the ground, and the upper air—he gave promise for the future to refrain from an old and destructive practice he had been in the habit of indulging in,—that of toppling over and destroying towers, chimneys, and other lofty buildings that chanced to attract his notice. And the fact of his having honourably kept this promise has led to a further study of his powers and peculiarities, and to the cultivation of more friendly relations with him than had been done before.

He is constantly hovering and brooding over the earth, mantling and pillowing himself in the clouds; sometimes marshalling them in hostile array against each other, travelling with them in their movements, and descending with them in union with the rain, to refresh and fructify the ground; ascending, also, as well as descending, by secret and imperceptible movements, in the fulfilment of the innumerable services which God has ordained him to perform. Though such is the usual and gentle manner of his transition between earth and sky, yet it sometimes happens, when he finds himself unduly confined on the one side, that he will make a sudden and irresistible bound to the other, overturning, blasting, and destroying whatever may stand in his way, and emitting a roar of thunder surpassing in awe-inspiring grandeur the cries of all the wild beasts of the forest blended together.

By following in the wake of the American *savant* electricians have succeeded in greatly mitigating—in many cases in entirely averting—the calamitous effects of such occurrences. Knowing the partiality he has for certain of the family of the metals, and the willingness with which he will accept of their guidance and means of transport, they have constructed roads (literally rods) of iron, copper, or bronze between the earth and the highest points of the chimneys and lofty buildings that were wont to be injured by him. These rods or tubes are provided with incorrodible points—

often trifurcate—at their upper extremity, and the Genie gives a very decided preference to this kind of passage, both by way of exit and entrance, and when making use of it he is quietly led either downwards or upwards, whichever way he requires to go, till all danger of a sudden outburst is past.

For many ages mankind were almost unaware of the presence among them of this powerful spirit; nor did they know that he was unceasingly employed in their service; and much less were they able to summon him at will to appear visibly and tangibly before them, to exhibit some of his wonderful powers. When at last they did succeed in this the utmost wonder and interest were excited by the display, although the form it took was what might at present be looked upon as mere childish tricks compared with the stupendous and beneficent powers of which he is now proved to be possessed. His favourite resting-place of retirement is, as I have said, deep in the interior of the world, from which, however, he is continually emerging and gliding to and fro through the earth and the air, doing an infinite variety of useful and beneficent work; after accomplishing which he, by the law of his existence, quietly retires to the place of his concealment. But if anything should stand in his way, or resist his passage, woe be to that person or thing! Personal injury, or even destruction or death, is sure to be the result.

While thus pent up, miles deep in the interior of the earth, and finding no ready means of escape, he will sometimes break the bonds of his prison and force a passage or place of exit for himself, and in doing so shake the earth for miles around, leaving great rents in it, overturning buildings, destroying millions' worth of property and thousands of lives. This heavy charge, at all events, has been brought against Electron as one of the various hypotheses that have been suggested in explanation of earthquakes. But though he may in some degree be connected with these phenomena, there is far from sufficient proof that he is the principal or sole agent, and in a Court of Science the verdict could not be more than "Not proven." But *if he be* the great cause of these terrible convulsions, might it not be possible that the happy invention of Franklin, which has averted so many of the disastrous effects of aërial and surface lightning, could also, in some way, be applied to the deep underground storms (if indeed the depth were not too great) which are supposed to be connected with earthquakes?

Colonel Arthur Parnell, writing on the subject in the

"Journal of Science" for December, 1883, adduces some passages from the Apocalypse to show that the inspired writer of that book considered lightnings, thunders, and earthquakes as being results of one and the same agency, though perhaps not of much scientific value as bearing on the question: these passages are sufficiently interesting and apposite to be re-quoted:—

"I saw the seven angels which stood before God, and to them were given seven trumpets. And another angel came and stood at the altar, having a golden censer; and there was given unto him much incense, that he should offer it with the prayers of all Saints upon the golden altar which was before the throne. And the smoke of the incense, which came with the prayers of the Saints, ascended up before God out of the angel's hand. And the angel took the censer and filled it with fire of the altar, and cast it into the earth; and there were voices and thunderings and lightnings, and an earthquake" (Rev. viii., 2—5). Again, "The seventh angel sounded, . . . and the temple of God was opened in heaven, and there was seen in His temple the work of His testament; and there were lightnings and voices and thunderings, and an earthquake and great hail" (Rev. xi., 19). And again, "The seventh angel poured out his vial into the air; and there came a great voice out of the temple of heaven from the throne, saying, It is done. And there were voices and thunders and lightnings; and there was a great earthquake, such as was not since men were upon the earth, so mighty an earthquake and so great" (Rev. xvi., 17, 18).

Notwithstanding the amount of work he is known to perform, Electron is also fond of dancing, and his favourite place for enjoying this pastime is in the neighbourhood of and around the poles of the earth. There, in a bright frosty evening, mortals may often get glimpses of his holiday garments fluttering and corruscating in all the beautiful hues of the rainbow, mysteriously vanishing and reappearing as he disports in the fantastic evolutions of his mystic dance.

It is not to be understood, from the repeated references to the favourite resting-place of Electron as being in the earth, that the sea receives less of his regard than the dry land. On the contrary, there is every probability that the sea is even more abundantly and unvaryingly his place of abode than the land. Water is far more congenial to him than land, and in it he can stretch out and rest himself more complacently than on land. His passage between the clouds and the sea will of course give rise to the usual phenomena attending similar transitions on earth, but there is nothing

in the ocean's boundless expanse of water to intercept his movements or rouse him to anger and violence. I believe that he is abundantly diffused through its whole extent down to its utmost depths, and that he is the means of imparting life and vigour, and exuberant—almost superabundant—fertility, to the multifarious and innumerable creatures that have their habitation there. The very atmosphere of the sea is impregnated by him to a greater extent than that of the land. The superambient air is ozonised or charged with his influence, and thus rendered, as is well known, salubrious and life-giving to invalids, after the ordinary resources of medicine have failed.

In illustration of these statements it may be allowable to refer to the significant fact that while there are at least a dozen fishes that are provided with electrical organs, and capable of using them both for sustentation and defence, there are no land animals known to be so endowed. The fishes referred to "belong to three widely different groups,—namely, rays, eels, and sheath fishes,—which would seem to indicate that electric organs have originated independently in each group. The electric eel of South American rivers is the most powerful of these creatures, growing to a length of 6 feet, and provided with a pair of batteries containing hundreds of minute cells, copiously supplied with nerves, and capable of sending forth a shock which will paralyse the largest animals." *

While it is only within the last few years that man has been able to make use of electricity as a weapon of war against his enemies, these creatures have for many thousands of years—probably before man appeared upon earth—been applying their electrical batteries to the art of capturing their prey,—electric batteries, be it observed, which "behave in exactly the same manner as those constructed artificially, rendering the needle magnetic, decomposing chemical compounds, and emitting the spark."

For the capture and taming of wild and vicious animals, might we not be able to take a hint from these facts in Natural History?

Electron exerts a mysterious but powerful influence on the sensations of living—probably all living—creatures. The behaviour of many of the lower animals gives well-understood indications and warnings of changes of weather to be expected from his approach or his movements. In the human body, also, he can by his presence induce the most

* Longman's Magazine for March, p. 529.

pleasurable and salubrious feelings, or sensations of the most disagreeable nature.

There are various ways in which the Magi at first succeeded in conjuring this potent spirit, making him give indications of his presence. Sometimes this was done by making a grateful and rapid friction with a metallic or other substance of which he is known to be fond, through the medium or interposition of a suitable receptacle placed in communication or *en rapport* with the earth where he resides. The result is that he comes gradually into the vessel or trap, and indicates his presence by a crackling noise and the emission of sparks, just as is done by him when the back of a cat is treated in a similar manner. At other times he was tempted to make his appearance by a dish of metals stewed in an acid, for which he has a well-known predilection.

But now, by God's permission, the power has been given to the wise men of various countries—more especially those of Britain, France, Germany, Italy, Russia, and America—to secure, bind, and imprison him in a leaden vessel or casket, and to seal it with the seal of Solomon the Wise, so that he can be kept there as the submissive slave of his captor, carried to a distance, and when released forced to perform whatever work may be appointed him to do. In this way he can, under proper superintendence, be made to perform the work of a domestic slave or servant, in sewing, washing, &c., and even in lying on the watch and sounding an alarm in the event of robbery or of fire. He can also be made use of as the motive power of vehicles and machinery of all kinds. In short, he can be made to perform any kind of mechanical labour which does not require the direct exertion of mind and intelligence—gifts which God has bestowed on man alone. In view of the grandeur and immensity of his attributes we might almost think that the following sublime language of St. John, in the Apocalypse, is intended to pourtray him!

Rev. x., 1.—"And I saw another mighty angel come down from heaven, clothed with a cloud, and a rainbow was upon his head, and his face was as it were the sun, and his feet as pillars of fire; and he had in his hand a little book open: and he set his right foot upon the sea, and his left foot on the earth, and cried with a loud voice as when a lion roareth: and when he cried, seven thunders uttered their voices. . . . And the voice which I had heard from heaven spake unto me again, and said, Go and take the little book which is in the hand of the angel which standeth upon the sea and the earth. And I went unto the angel

and said unto him, Give me the little book; and he said unto me, Take it, and eat it up, and it shall make thy belly bitter, but it shall be in thy mouth sweet as honey. And he said unto me, Thou must prophecy again before many peoples and nations and tongues and kings."

The variety of designations that are given to Electron by scientists is apt to perplex those that are not familiar with the subject. These have been given according to the sources from which he can be educed, the forms he appears in, and the functions he performs,—such as positive and negative, static and free, Voltaic, Franklinic, and Faradaic, animal, frictional, and magnetic; and many besides. But these names, like the roll of names often given to potentates of the world, all belong only to the *one* great Genie who is the subject of our present discourse.

The motions which God has given to the great oblate globe of the Earth must, we should expect, cause relative motions on the part of such a mobile and ethereal substance (if substance it can be called) as that of this great Genie. We do not know the natural laws by which spirits are governed, but, speculating on their analogy to those which apply to the rarest of fluids and gases that we are acquainted with, we may to some extent be assisted to understand how such a spirit would comport itself in the world; though even the laws of acoustics or of hydro-dynamics cannot properly be considered as altogether applicable to so immaterial and imponderable a being as Electron.

The natural effect produced on these fluids by the rotation of the Earth would be centrifugal at the meridianal circumference and centripetal at the Poles. In the case of the Electric Spirit, supposing, as some with reason think, that it *has* the slightest amount of gravity, the rotary motion of the Earth would, at both ends of its axis, tend to draw it into the interior, which it would penetrate and traverse as easily as if it were a hollow sphere, and, the motion of the globe being greatest at its equatorial circumference, the spirit would find its way there; it would issue forth (refreshed and invigorated by his passage through the central fire of the Earth), imparting warmth and fertility to the tropical regions, though often giving indications of his superabundant presence, by frolicksome outbursts, which are sometimes attended by disastrous consequences. And thence he would become diffused through and over the atmosphere, and so would find his way back to the Poles, there to be again absorbed, and to enter on what might be called his normal circuit of the Earth. Thus the Earth

sustains the part of a vast storehouse, continually receiving detachments from this Spirit of the Universe by its great polar and other entrances, and as continually giving forth supplies by even more numberless exits.

Though one of the principal agents in carrying out the laws by which God governs the world, Electron is himself subject only to such laws as are adapted to his constitution and the purposes for which he was created; and the Supreme Governor has given permission to man, when he ascertains and pays deference to those laws, to make his own use, to a limited extent, of the powers and the service of this great spirit.

This powerful and ubiquitous Genie has close relations with all animate and inanimate things in the world. Between him and some of them there is a much greater attachment than with others, as, for instance, in the case of the metal iron, that greatest friend and servant of man of all the metallic race.

The further our researches and observations have yet been carried in this direction the more they tend to confirm the belief, inspired also by the study of other branches of natural science, that the Almighty wisdom and power operate by means at once the most uniform and simple in their individual and atomic manifestations, and unspeakably efficient, grand, and beautiful in their combined and predestinated outcome. The Universe itself consists of an infinite number of globes or spheres, in constant, regular, and multiplex motion, and having certain sympathetic influences and relations with each other through means of a property called gravitation. The ultimate or minutest division which we are capable of making of matter, as well as the most careful study of its properties, lead to the same conclusion as to its constitution, namely, that its atoms or ultimate components are also spheres either in motion or capable of being put in motion, and having opposite poles and attractive powers for other atoms, whether of the same or of different species. But instead of being called gravitation the attractive force of these atoms is known as chemical action, though it is believed by *savants* to be the effect of some special properties conferred upon them by Electron. And it is—beyond all his other qualities—by his power of imparting and governing molecular attractive forces that such all-important results are produced throughout the world as prove the Genie Electron to be the most powerful and omnipresent of God's ministers on earth.

When the particles of different kinds of matter are free to

mingle with each other—which by means of heat, air, water, and other media they can be made to do—he can make them change their arrangements, and can subject them to such magical transformations that they become entirely new substances, with appearance and qualities essentially different from their previous condition. That *he* is the immediate agent in effecting this may be fairly inferred from the analogous work he is known to do on a larger and visible scale, as well as on other reliable scientific grounds.

We can easily see the results and the accompaniments of this great spirit's working in many of the phenomena of the world, but no man has ever yet seen him *actually* at work or discovered his precise *modus operandi*. When God made himself known to Elijah it was not in the tempest, the earthquake, or the fire, but in the still small voice in the Desert. And so it is that the silent and secluded chamber of the scientist is also the most congenial and favoured place for contemplating the working of His great minister on the Earth. By long-continued transformations of the kind described he has changed, and is still changing, the aspect and condition of the surface of the world, and it is by a knowledge of these powers, and by the wisdom to take advantage of them, that most important results both to the initiated scientists, and, through them, to the world at large, are to be obtained. Out of three or four elementary substances, for instance, he can, under propitious circumstances, form a vast number of things, of very diverse qualities, adapted to enrich, sustain, and beautify the world and its inhabitants. Like a skilful general, or a clever master of ceremonies, he can place his subjects (small and invisible to us as they individually are) in all manner of composite groups, and in every variety of arrangement, and by his signal of command can make innumerable hosts of them embrace and coalesce, so as to constitute new masses, possessed of a character and qualities very different from those they had before, as well as from some other groups composed of the same elements. By operating through means of the different degrees of mutual affectian between these atoms and their chief, and for each other, he can bring about a sharp and rapid conflict amongst them, leading to their separation and rearrangement, so as to form new groups with characters and powers very different from those belonging to the previous groups, or to the individuals composing them. Individuals previously harmless or benign he will sometimes combine together, so as to form a band of poisonous murderers. Awkward and spiritless dolts he can

associate, match, and arrange together in such a way as to develop in them high-spirited and estimable qualities. By selecting, drilling, and arranging a lot of the most worthless and unattractive of things, he can turn out some of the most beautiful, useful, and valuable combinations that have in these times enriched the world. But besides the changes in regard to qualities easily recognised by our senses, such as colour, taste, and smell, there are many other and more subtle changes which he can effect that are not so readily appreciated by us.

The exact *rationale* of these changes is, I suspect, almost beyond our comprehension. With regard to colour, knowing as we do that Electron, if not identical with light, is allied and even superior to it, and may therefore be believed to have some command of those elementary colours contained in light, and it is quite conceivable that the molecules and the ultimate atoms of matter may have, through the influence of Electron, special affinities for certain of these coloured elements, or specially electrised atoms, if such they be, as we know that they have for the other spectroscopic elements of light, and that they will, in consequence, reflect some but absorb others, appearing in that colour which they reflect, and showing black if they absorb all, but white if they reflect them all.

So subtle and all-embracing is the essence of this great Genie that there is no part of the World, or of what it contains, that is not more or less imbued with it. But, though embracing all things, he shows a decided preference for some above others, and this in so manifest a way that the Magi who are devoted to his service have had no difficulty in making out a list of things in the order of his preference for them. Among those for which he shows the highest favour and attachment are the great family of the metals, and it is chiefly through their means that mankind have been enabled to become acquainted with his character and qualities, and with at least some of the laws by which he is governed in the work which God has ordained him to do. By their means it is, too, that his extraordinary powers are being more and more applied to the direct service and benefit of mankind. For example, while *we* can travel at the rate of a mile per minute along an iron railway, one of the same material, at a fraction of the cost, can be made to convey Electron with whatever store of intelligence we choose to entrust to him, thousands of miles, and to any part of the world, in the same space of time.

(To be continued.

III. ON THE CHLOROPHYLL OF LIVING PLANT-CELLS, AND ON THE ASSIMILATION OF CARBON.

WE purpose laying before our readers the results of certain investigations which Dr. J. Reinke has communicated to the German Botanical Society, and which have appeared in its "Berichte" (Proceedings), as well as in the "Naturforscher" and in other foreign journals.

The reduction of the carbonic acid of the air is a function of light and of the chlorophyll of living plant-cells. If we wish to understand this process—the very foundation of vegetable nutrition—we shall find a study of chlorophyll in its solutions insufficient. We must instead, or in addition, examine the behaviour of chlorophyll with light, whilst it exists in the living vegetable cell. The remaining constituents of the living cell do not appreciably interfere, as in a purely green leaf they consist of colourless, transparent substances, which absorb light in a manner similar to chlorophyll, though less powerfully. In the case of transmitted light they are therefore inactive, and merely reduce the degree of illumination by reflecting and refracting a certain portion of the radiations.

The air which is present in leaves has doubtless a disturbing influence, on account of its low refractive power. Dr. Reinke expels it from the leaves by means of water, and thus obtains very satisfactory results.

He has determined the absorption-spectrum of the chlorophyll of the living cells in the leaves of numerous phanerogamous plants, by means of a micro-spectroscope. The various species show no differences of importance. All agree in proving that the absorption-spectrum of chlorophyll as contained in the living leaf is always different from that of chlorophyll in solution. This result, we must remark, contradicts the statements of former observers. Dr. Reinke gives a drawing of the spectrum of light which has passed through living leaves. We notice here two main absorptions, separated from each other by a minimum which lies at the wave-length 550. In the original illustration the absorption-spectra of different strata of the leaf are drawn one above the other, so that they unite to form a picture of the increase of the absorption with the number of the ab-

sorbing strata. The absorption-spectrum of an alcoholic solution of chlorophyll is given by way of comparison.

If we disregard the more highly refractive portions we find in the spectrum of a leaf only the band I., as broad as the bands II., III., and IV. appear in the spectrum of the solution. If we superimpose three leaves upon each other, I. becomes considerably broader than in the spectrum of the solution, II. and III. appear faintly indicated, whilst IV. is still wanting. If we use five leaves, I. appears twice as broad as in the solution, whilst IV. comes up as a faint shade. With six or seven leaves it becomes more distinct, but disappears again in the spectrum of eight or nine leaves.

The spectrum of living leaves is thus essentially distinguished from the spectrum of the solutions of chlorophyll by the comparative feebleness of II. and III., and by the quite rudimentary character of IV. These facts show that the chlorophyll of solutions is chemically not identical with the chlorophyll of living leaves. In other words, the latter, when taken up by any solvent, always undergoes a chemical change. Comparative experiments show that the effect of treating chlorophyll with a weak acid consists mainly in an increase of the strength of the band IV. Hence we are led to the conclusion that chlorophyll, as it exists in solutions, corresponds chemically to chlorophyll modified by acids.

The difference between these two kinds of chlorophyll, as observed in the absorption maxima, may be traced also in the minima, which lie between the wave-lengths 720—700 in the extreme red, and between 560—540 in the green. In the absorption-spectrum of leaves the red did not disappear until the light had been passed through a stratum of sixteen leaves. The green was perceptible even through a layer of eighteen leaves, whilst it is more strongly absorbed by concentrated solutions.

Though Dr. Reinke comes, in the points above mentioned, in collision with the results of earlier experimentalists, yet, as regards the fluorescence of the chlorophyll of the living cell, he agrees with the majority of observers. He finds the chlorophyll of living leaves non-fluorescent, whilst, as is well known, solutions of chlorophyll display a very fine red fluorescence. Reinke explains this fact by the consideration that the chlorophyll in the leaves does not exist in a state of solution. The absence of fluorescence depends, consequently, on the state of aggregation of the chlorophyll. That its condition in this respect is decisive may be learnt from the following experiment :—Chlorophyll obtained from

a recent alcoholic extract was dissolved in melting paraffin, and displayed the same intense fluorescence as in the alcoholic solution. On allowing the paraffin to cool, when it congealed to a transparent cylinder of a uniform green colour, it did not possess the slightest fluorescence, which, however, returned on melting the paraffin. Hence it would follow that chlorophyll is present in plants in the solid condition, and not in solution.

The colour in which leaves appear to us is green. The light reflected by leaves consists, as both Reinke and Lommel have found, of the same radiations which have passed through a single leaf,—*i.e.*, the extreme red nearly as far as B, and the rays between C and E, in moderate intensity, whilst the dark green and blue are only faint. A spectroscopic examination of the sunlight reflected from illuminated leaves shows the absorption-spectrum of chlorophyll very distinctly. That a light which consists of red, 720—700, and green, 540—520, should appear to us green is explained by Reinke by the consideration that our retina is much less sensitive to red than to green, and whence the former is less prominent in the general sensation.

These remarks on the light reflected by foliage and grass may, perhaps, explain an anomaly in the sphere of art. Landscape-painters generally find the green of trees and fields a very difficult colour to reproduce to their satisfaction. Again, we admire the effects produced in Nature when blue flowers—such as the wood-hyacinth, the harebell, the gentian, or the forget-me-not—appear in close juxtaposition with the green of leaves. Yet we find that in the decorative arts it is not easy to combine blue and green advantageously. We may now see the reason for these anomalies. Our green dyes and pigments differ widely in their optical composition from chlorophyll.

Dr. Reinke, in passing to the important question of the relation of living chlorophyll to the assimilative process, points out that the colour—*i.e.*, the impression which the leaf of a plant makes upon our eyes—bears no relation to the reduction of carbonic acid. On the contrary, we have here to consider exclusively those luminous undulations which are absorbed by the leaf, since only light which is absorbed can be transformed into any other form of energy within the absorbing body. Earlier observers have not overlooked this point. Thus Dr. Lommel concludes that the maximum of the reduction of carbonic acid, and the absorption of carbon, coincides with the absorption-maximum I. of the spectrum of chlorophyll. He conceives that each

molecule of a body is, so to speak, attuned to a certain number of vibrations, and when it is struck by light waves, vibrating in unison with it, these waves give off their *vis viva* to the molecule, the light is absorbed, and its *vis viva* performs chemical work. As, however, the number of vibrations plays a certain part in chemical action, as is proved by the behaviour of silver chloride with the violet rays, it is possible that the rays of shorter undulations are of importance in the process of assimilation. Hence Lommel's conclusion that the maximum of assimilation coincides with the maximum of absorption I. can only be regarded as a probability resting on theoretical considerations.

Prof. Hoppe-Seyler has also pointed out that emissions and absorptions of light are effected not by the entire molecule, but by atoms and groups of atoms. As the greatest part of the sunlight which impinges upon a solution of chlorophyll is converted into red fluorescent light of the wavelength of the spectral region between B and C, the atomic group which emits this fluorescent group must be freely and widely movable. The supposition lies, therefore, near at hand that it is this atomic group which splits off oxygen in the living plant.

Experiment, alone, however, is entitled to give a valid and final answer to this question. Assuming that the liberation of gas by *Elodea Canadensis* gives an expression for the intensity of assimilation, Dr. Reinke shows that the maximum of assimilation lies between B and C, falling off very abruptly towards the less refrangible side, and also, though more gradually, on the refrangible side. In the less refrangible portion of the spectrum the curve of assimilation runs almost parallel with the curve of absorption if we overlook the two smaller maxima of absorption II. and III., which latter seem to be as unimportant for the decomposition of carbonic acid as is the absorption in the violet ray. The author arrives, therefore, at the following conclusion:— Assimilation appears, in accordance with the corresponding course of the curves, to be a function of absorption in that atomic group in chlorophyll, and in all its more immediate products of decomposition readily absorbs the rays between B and C, and in a dissolved state emits rays of the same wave-length as fluorescent light.

Dr. Reinke gives a theoretical explanation of this experimental fact. He holds that the atomic group (γ) of chlorophyll, on the activity of which depends the decomposition of carbonic acid, is inclined to oscillate with the velocity of 440 to 450 billions per second, and is most readily set in

motion by rays of this rate of vibration, whilst rays of either greater or less refrangibility do not produce this result.

Assimilation, therefore, is a function of the undulatory power of the atom in the atomic group, and of the chlorophyll molecule,—that is, of its chemical activity. As it is also a function of the light-rays of that number of oscillations which can set this atomic group in motion, we may say that chlorophyll assimilates the *vis viva* of light, transforming it immediately into atomic vibrations, on the energy of which the splitting up of the carbonic acid depends; the chemical work of the reduction process is only indirectly supplied by light.

We may conceive that the vibrations of the atomic group γ are not first produced by light, but that they take place also in the dark, though of too small amplitude to effect the work of assimilation. Light increases this amplitude, and is a condition even for the smallest decomposition of carbonic acid. The result of the chemical process increases then in proportion to the increase of the intensity of light up to a maximum value of the vibratory amplitude, which cannot be further augmented by an increased illumination.

Whether the chemical action of the group γ in the process of assimilation is direct or indirect, is not decided by what has gone before. That the latter alternative is possible appears from the researches of M. Becquerel, which prove a very interesting indirect action of chlorophyll. Whilst silver chloride is decomposed only by the so-called photographic rays of sunlight, M. Becquerel observed, in a mixture of silver chloride with chlorophyll, the separation of metal in those parts of the spectrum which correspond to the absorption-bands of chlorophyll.

Dr. Reinke further discusses the relation of assimilation to fluorescence, and puts forward the view that we have here two reciprocal phenomena which may even be mutually exclusive. The green cell would not assimilate if its chlorophyll was fluorescent. Fluorescence occurs with great motility of the chloroform molecule in solution. In solid chlorophyll the transformation ensues in another direction,—that is, in the reduction of carbonic acid, when the chlorophyll occurs in the living cell, and when carbonic acid is present.

IV. "TECHNICAL TRIALS."

By An Old Technologist.

WITHOUT any fear of contradiction, it may be said that of all the proceedings in our Courts of Law the least satisfactory are so-called technical trials, —*i.e.*, cases, civil or criminal, where the question at issue turns upon some point in the physical sciences or in the industrial arts.

Of such "technical trials" there are several varieties. There are—not often, indeed, though if we are to believe that celebrated "amateur chemist" the Home Secretary, less frequently than there should be—trials for murder or malicious injury by poisoning; there are actions for nuisances and for infringment of patents; there are investigations respecting explosions, the shortcomings of machinery, and the defects of buildings, all of which require for their right adjudication a special acquaintance with chemistry or physiology, or physics, or mechanism, as the case may be. In such trials knowledge of this kind is too often conspicuous by its absence, alike in judge, jury, and counsel. I have no wish to disparage either of these three divisions of the *personnel* of our Law Courts. Our juries, if somewhat—like Englishmen in general—too easily swayed by rhetoric, are doubtless fully equal to the duties ordinarily required of them. As far as common sense and a knowledge of men, of the world, and of business will go, they may be safely trusted. But all these qualifications, joined to the most sterling desire to do even justice are simply as naught in cases of the kind I am discussing. They have to deal with evidence which to them is often as unintelligible as if it were conveyed in some foreign tongue.

Nor is the slightest advantage gained if a special is preferred to a "common" jury. On the contrary, a body of twelve esquires or merchants may prove more at sea than would an equal number of artizans.

Our judges and barristers, in general, well deserve the epithet of "learned," which the courtesy of reporters rarely omits to bestow. In law itself, in history, politics, ethics, and in the classical languages their erudition is not to be challenged. But, as a rule, their acquaintance with physical science and industrial art is neither remarkable for its extent, its depth, or its clearness. Exceptions doubtless

occur. There is, I believe, at present one judge upon the bench who is fully competent to deal with scientific evidence. But we shall the better understand the rarity of such qualifications if we remember that a brilliant and versatile Lord Chancellor, concerning whom it was said that "he would have known a little about everything if he had only known a little law," proved, by his pitiful critique of Young's researches in optics, how infinitesimally little was his knowledge of physics. I fully recognise the ability which counsel often display in "reading up" some subject which is involved in any case they may have in hand. But the knowledge thus acquired is often deficient in clearness, and is sometimes more adapted for baffling a supposed hostile witness, or for bewildering a jury, than for arriving at the truth. It may, perhaps, be questioned whether the entire training of a lawyer is not (unless he has made a special study of some department of natural science) liable to give him a bias which is here to be regretted. He is accustomed to search for truth not in things, but in words, spoken or written, and he consequently is apt to lose the power of learning from things. He is also, in his ordinary sphere, necessarily swayed by authorities. Hence in "reading up" for (say) a poisoning case he attaches an exaggerated importance to the works of Christison or Orfila, of Liebig or Fresenius, even when visible and palpable facts are much the safer guides.

Having thus dealt, as I fear some will think rather uncourteously, with the bench, the bar, and the jury-box, I come to the experts summoned as witnesses. I saw, some little time ago, in this Journal, the alleged dictum of a judge that while he had "a great respect for professional witnesses, he had none for witnesses by profession." Now of all men concerned in a technical trial the expert witness is placed in the most radically false position. He is supposed to be, like every other witness, the partizan of the side by whom he is called. Often—too often, indeed—he is so in reality. Hence comes the scandal, with which we are all but too familiar, of scientific men contradicting each other in a manner little creditable to Science, and certain to lead any impartial hearer to one of two very derogatory conclusions. "Either," it will be, and it has been said, "Science can lay but little claim to certainty, and is rather a mass of doubtful speculation than a body of demonstrable truth, or else these experts are men who for a fee will say anything." No one I fear can read, *e.g.*, the report of the trial of Palmer, or of the great Torbane Hill case, without entertaining very painful reflections. In fact, some of the most eminent scientific men

systematically refuse to undertake any investigation which may ultimately compel them to give evidence before a Court of Law. They decline to accept a position which may subject them to insults for which neither the law nor public opinion gives them any redress. No less do they object to be supposed capable of wresting the truths of Science for a fee, or to serve the interests of any man. Hence it frequently happens that the public lose the advantage of having those truths, as bearing upon the case, expounded by the highest authorities.

But how is this unsatisfactory condition of things to be amended? A recent writer proposes that for such trials there should be a new and distinct kind of jury empanelled, consisting of men more or less acquainted with the physical or natural sciences, and accustomed, in virtue of their calling, to observe facts and to draw thence accurate conclusions.

Such "more special" juries should consist of medical men, pharmaceutical chemists, engineers, chemical analysts, works' chemists, architects, &c. It is urged that at present much time is wasted because the jury do not understand the technicalities of the case. If we suppose a trial concerning the novelty of a machine. The language in which its different parts and their movements are described is to the twelve good and true men,—whether "common" or "special"—about as intelligible as if it were given in choice Sanskrit. The jury do not clearly understand the professional witness. What makes the matter worse is that, very often, counsel is in the same predicament. Further, one of his ordinary functions is, if he cannot confuse the witnesses called on the opposite side, at any rate to prevent the jury from forming a correct opinion as to the facts brought forward, and as to the conclusions to which they point. Now, it is submitted, that a jury of the new proposed kind would have at the very outset a serious advantage. They would understand the technical language used; they would be able to decide, of their own knowledge, whether the evidence given on either side was in accordance with known facts and with established theories, and they would see directly and not through the somewhat perturbing medium of counsel, to what conclusions such evidence pointed. It is further submitted—and not without a certain amount of truth—that, before such a jury, expert witnesses would be exceedingly cautious in advancing nothing of a doubtful nature, and would simply tell "the truth, the whole truth, and nothing but the truth," according to their belief and knowledge.

But admitting all these advantages of the new technical juries, I must still point out some grave objections to the proposal. In the first place, medical practitioners and pharmaceutical chemists are at present by law exempt from serving on juries, and that for reasons which must at once commend themselves to the common sense of the public. The great body of chemists and druggists are claiming the same exemption, and on the very same grounds. It is not likely that these numerous and organised bodies would willingly forego their present or hoped-for immunities, and consent to act as jurymen in what are often the most tedious cases. If, then, they could not be counted on, it would often, in country districts, be difficult to find a sufficient number of persons qualified to sit on a technical jury. Engineers, architects, works' chemists, analysts, college professors, &c., would, further, be fairly entitled to claim exemption from serving on ordinary juries, if made specially liable to this kind.

A far more important point is that unless special care were exerted in selecting such a technical jury, it would not have the advantages sought for. Let us, *e.g.*, suppose a trial for an alleged infringement on a patented improvement in locomotive engines. The court has summoned at random a sufficient number of persons from the technical jury-list, and when the trial begins the panel is found to consist of physicians, surgeons, a chemical analyst, and a professor of botany from ——— College. In this very possible case, where will be the advantage as compared with an ordinary or a special jury? The jurymen will be as ignorant of the technical language of the subject before them as would be an equal number of "esquires or merchants." They will not know, of their own knowledge, whether the statements made by witnesses are in accordance with recognised truth or not. They will still require to have the facts elicited explained to suit their comprehension, and they will thus be liable to be led astray.

I take another case: Suppose Palmer being tried over again. Let the jury comprise four medical men and two chemical analysts, but let the residue be made up of architects and engineers, with a professor of geology. Here, again, the advantages would be problematic. The first six would understand the technical language of the case. They would be able to sift for themselves the evidence offered. The physicians would know the meaning, *e.g.*, of certain symptoms deposed to as having been observed before death, and of certain appearances noted during the *post mortem*

examination. The analysts—and to a certain degree the physicans also—would be able to judge whether the best known processes had been employed for the isolation and recognition of the poison, whether all necessary precautions had been taken, and whether the reactions obtained were conclusive. But the engineers, architects, and geologists would have little or no advantage over an equal number of country gentlemen, bankers, merchants, or even retail tradesmen. They would not understand the technicalities of the case; they would not know the meaning of symptoms and reactions. Hence this portion of the jury would be open to be led astray by the statements of experts and the appeals of counsel, and on retiring to consider the verdict they would need to be put right by their specially-qualified colleagues.

I shall not, I hope, be accused of hypercriticism if I go a little further. It is commonly supposed that a qualified medical man is competent to give an authoritative opinion on any question falling within the wide and somewhat ill-defined boundaries of "medical science." This, however, is by no means the case. A professional man of standing, summoned on such a jury as I have been supposing, might happen to be a specialist in mental alienation, in gynæcology, in affections of the eyes, or he might be what is technically called a "pure surgeon," skilful and experienced in operations. Such physicians or surgeons might easily happen to have had absolutely no experience at all in cases of poisoning, whilst their chemistry may have been allowed to rust in peace since the day when they passed their examination. Such men, I submit, will be of no special use in the trial of a poisoning case.

I may go still further: Among analytical chemists of recognised learning and ability, there are many who never have concerned themselves with toxicology. They may have, *e.g.*, extensive experience in metallurgy, in the chemistry of dyes and colours, or in that of fermentation, but they would be unable to decide, without "reading up," whether certain reactions described by an expert witness were conclusive evidence of the presence of strychnine in an organic mixture or not.

Thus as we examine more closely the benefits to be derived from a technical jury they seem to become fine by degrees and beautifully less.

There is yet another difficulty, perhaps the most serious of all. I refer to professional jealously, which would here come seriously into play. This element, I admit, is not

entirely absent under the existing system. It is not for me to take up the published reports of any celebrated trial, and say that such or such an opinion given by Dr. B. in the witness box was more or less dictated by private ill-will to Professor A., who had been called by the opposite side. Yet at the time of some of the great poisoning trials there prevailed an uneasy suspicion, both in medical and legal circles, that some of the evidence given had been at least coloured by this unworthy feeling. But, under the proposed system, there would be, as it seems to me, three channels through which professional jealousy might make itself manifest. Experts between whom there is "no love lost" might still, as now, be called to give evidence by the opposite sides. Or, again, suppose a trial where the issue is the pollution or the non-pollution of a certain well. In the witness box stands Professor X., who states that he has analysed the water by his own method, which he maintains is the only trustworthy process known, and that he has found such and such results. In the jury box sits his rival Professor Y., who declares that the method used is utterly worthless, the amount to be determined being smaller than the limit of error, and that a certain other process ought to have been employed. Should we not then have the jury cross-examining such a witness in a more offensive and imputative manner than is now done by counsel? In the third place let us suppose our two rival professors both on the jury, scarcely to be kept within the bounds of public decorum, whilst counsel seek to foment the quarrel. Let us imagine the scene afterwards, when the jury retire! In all probability they would be discharged as unable to come to any decision, and a new trial would become necessary.

There are, however, cases where a jury of experts, in a form perfectly practicable as the law now stands, would be extremely useful. I will take the following instance, no mere apologue or parable, but, save for the suppression of the names of persons and places, an actual fact:—Messrs. C., dyers, sued Messrs. E., another firm of dyers whose works were situate higher up on the same stream, for injury done to their trade by the pollution of the water with waste dye-liquors, &c. The case was tried in London, and there was an immense outlay incurred in bringing up witnesses, analysing samples of the water above and below the point where the pollution was said to have originated, and the final result was a compromise. Now, if the case could have been tried on the spot before a jury of dyers, who could first have inspected the stream and then adjourned to the dye-

houses and seen the work which was being done with the alleged "polluted" water, they would in a few minutes have been able to reach a more exact conclusion as to the injury sustained than all the chemical and spectroscopic analyses brought forward, and all the orations of eminent counsel could or did lead to. This case, doubtless, might serve for a type of many in different arts.

I may be asked, since the scheme of technical juries does not appear to me totally unobjectionable, what remedy I should propose? My plan is very simple, and has to some extent been already tried. Let the experts not be "called" by either plaintiff or defendant, or indeed act as witnesses at all, but let them be appointed by the court as assessors to the judges. Just as the latter gives an authoritative exposition of the law of the realm as bearing upon the case at issue, so these experts would expound to the jury the conclusions of Science as bearing upon the case. They would be under no temptation to speak as partisans, since the success of either party would be to them absolutely immaterial. They would be exempt from either examination-in-chief or cross-examination. Consequently there would be nothing to deter men of the highest eminence from giving the court the benefit of their knowledge and experience. The jury would receive their opinions continuously, not in the fragmentary form of a catechism, and counsel on either side would have no scope for perverting their utterances or making them unintelligible to the jury. Finally, I would recommend that in all such cases as nuisances, machinery, manufacturing processes, &c., the Court should adjourn to the very locality and to the objects concerned, and see, as far as possible, with its own eyes, which would save much talk.

As I have been discussing the composition of juries, I may, perhaps, indulge in a few remarks not strictly relevant. It is well known how women are gradually asserting their rights to a share in certain functions formerly deemed to pertain solely to men. They have obtained the power to vote in certain municipal and local elections, and to take their seats, if elected, on a variety of Boards. They are now demanding the Parliamentary franchise, and seats in the House soon will follow. But I never hear of them claiming to serve on juries. Is it that they draw a hard and fast line between what are commonly called "rights" and "duties," political or municipal, and that whilst eager for the former, they are quite willing to overlook the latter?

V. THE HEALTH EXHIBITION.

ONCE more South Kensington—the concrete, not the abstract—is *en fête*, swept and garnished. Once more she has thrown open her gates; and the exhibitor and the getter-up of exhibitions, the critic and the would-be purchaser, the lounger and the consumer of refreshments err through her mazes.

After a first and not un-admiring glance at the varied and animated scene, our next thought was astonishment at the ingenuity displayed by exhibitors in bringing their articles into some sort of quasi-connection with public health. We feel convinced that if that often-cited personage, the "intelligent stranger," could be suddenly transported from the ends of the earth and set down in one of the courts or the galleries without having seen any of the advertisements or prospectuses of the display, he would be utterly unable to guess that it was in any especial way connected with health. Let us take the entrance-hall devoted to food-products. That food is a very important factor of health no one will dispute. But what do we see here? There are certainly some most interesting exhibits. The stall of an Austrian Vineyard Company displays the dreaded *Phylloxera* in its different stages of development, and roots of the vine suffering under the visitation. There are also specimens of wines undergoing morbid changes. There is another stall showing the varieties of coffee grown in different soils and climates. There are similar exhibits of teas. Here the public will find something to learn and remember. Very near at hand is the display of the British Bee-keepers' Association. Here we see preserved specimens of Ligurian, Syrian, and Cyprian bees, hybrids, queens, drones and workers, fruitful workers, and the progeny of the latter. There are cells of each class of bee in the successive stages of development of the larvæ. There are, too, specimens of honey. One kind, of a whitish colour, was labelled as collected exclusively from white clover. Another, of a peculiarly rich golden tinge, was from lucerne,—a plant dear to every entomologist, on account of its attraction for numbers of insects. Still we feel a little doubt as to how the bees can be persuaded to devote themselves entirely to one kind of flower.

But in this same food department there was also much neither novel nor instructive, and which can only be regarded in the light of an advertisement. Piles of tins of condensed milk, of Australian meat, and of preserved vegetables can be seen in many shop-windows. "Animals from the London markets," stuffed, convey also little instruction. In one display of this kind, belonging to a taxidermist,—or, as our friend Mr. S. Butler would say, to a "man who seasons the skins of owls,"—there were actually a huge stuffed dog and a puppy. This display may perchance lead foreigners to believe that John Bull, like John Chinaman, regales himself upon "stewed bow-wow," or that the youth of the "period" indulge in cannibal repasts of puppy-pie. New sources of food do not form a prominent feature, human ingenuity having perhaps already tried everything available.

Adulterants, substitutes—or, as our German neighbours facetiously call them, "surrogates"—for various kinds of food, were not wanting. Thus we saw, on the stall of a Dutch exhibitor, the word, and the thing, of ill omen, "margarine boter," and the question rose to our minds whether this sample and the bulk which it represents had undergone any treatment certain to destroy microbia.

Along with coffee there was its simulacrum chicory, which, in spite of Viscount Halifax and Mr. Gladstone, we must persist in regarding as an adulteration. Why is not tea, in like manner, exhibited and sold as "mixed with a portion"—modest word!—of the purest slow-leaf? There was a stall of preserved fruits manufactured in Gloucestershire under improved auspices. The fruit goes direct from the orchards to steam-jacketted pans, and receives no admixture save the finest lump-sugar. Whilst giving our tribute of applause to the nobleman who in this manner finds employment for a number of persons, and a remunerative use for some hundred acres of land which might otherwise revert to the barbarism of "permanent pasture," we should like to ask whether the sugar used is real saccharose or only "betose"? An exhibit showing the physical differences between these isomeric bodies would have formed an interesting feature.

In what are commonly called sanitary inventions the Exhibition is fairly rich. There are devices for preventing the scullery-sink from being blocked up with congealed fat. There are effluvia-traps and soil-pipes of various kinds. But we fear that no syphon, however constructed, can prevent the sewer-gases from interchanging through the water with the air of the house. There is an apparatus which is

to get over, or round, the sewage difficulty by carbonising excreta and refuse generally in a special furnace, and using the gaseous products to light the house. We fear such gas, whatever its "candle-power," would be slightly mal-odorous, and should dread the occurrence of an escape. We scarcely see, however, how this device is to deal with urine, soap-suds, &c., which are generally more offensive and dangerous than the solid refuse of a household.

The electric light may safely claim a place in a Health Exhibition, since if adopted it will deliver us from the sulphurous acid, sulphuretted hydrogen, carbon monoxide, &c., which coal-gas diffuses in our dwellings.

Cooking-implements influence our health to no small degree. We were therefore pleased to see pans enamelled with a composition warranted free from lead or any other poisonous metal. In like manner pans lined with nickel and aluminium deserve commendation. But copper and brass pans, bare within, or lined with what is by courtesy called tin, but which is in deed and in truth an alloy of tin and lead, were still there, in full despite of modern medical and chemical science. We cannot here help recommending all whom it may concern when about to purchase any utensil lined with tin, to rub its inside with a bit of clean white paper: if the paper is at all blackened lead is present, and the best policy in that case is briefly conveyed by an emphatic *don't!*

Furniture and appliances for the sick room are not wanting, and seem constructed on very satisfactory principles. Everything of wood is of a light colour, and is thickly coated with a varnish, so that there may be no possibility of the absorption of anything of an offensive or infectious character, liquid or gaseous. We noticed in this department a small cupboard, beautifully lined with a white enamel.

Stoves and ranges of the most varied character are to be seen, both for warming and for cooking. Many of the former, though tasteful and worthy of notice from an æsthetic point of view, have no perceptible sanitary bearing. One of the most pleasing in appearance is the "Nautilus stove," which is shown in several sizes. Whether it does not throw too much of the radiant heat upwards, instead of down upon the floor and the feet of the occupants, is perhaps doubtful. Some few of the cooking-ranges have the oven heated from below, on the sensible plan general in the north of England. Kitcheners manufactured south of the Trent generally have the cardinal faults of using a small bulk of fuel at a very high temperature.—which is necessarily wasteful,—and of applying the heat from above.

Among gymnastic appliances we may mention Zander's arrangements for the movement-cure, as in successful use in the well-known establishment in Soho Square.

Certain model-houses were not complete at the time of our visit. In this important sphere we have still very much, if not to learn, yet to put in practice. So long as the short building-leases customary in London are tolerated, and so long as a number of persons can squeeze themselves in between the land-owner and the tenant, so long will "jerry-work" in building prevail, and even increase.

It is generally owned that, as far as a picturesque effect is concerned, our domestic architecture has greatly fallen off since the days of good Queen Bess. But it is sometimes asserted that, as far as healthiness is concerned, it has as distinctly improved. This is a flattering delusion. We have, indeed, abolished domestic cesspools; but their modern substitute, the water-closet, is often so carelessly constructed that it may be called an arrangement for supplying to every house sewer-gases and the microbia which they hold in suspension. We have sewers, which the olden time had not; but they are brought right under the floor of our dwelling-rooms, and between their imperfect and leaky surfaces and our noses there is sometimes merely the flooring. Nay, it even happens that the soil from our water-closets and the slops from our sinks do not find their way completely into the main sewer, but escape through defective connections and stagnate about the foundations. In such cases the abolition of the cesspool is merely a change of names, not of things.

Again, look at the walls dividing room from room. In the days of old they were built of brick and mortar; now they are merely hollow shells of lath and plaster, affording a secure retreat and breeding-place for cockroaches, mice, and rats, where the excreta of these vermin and portions of food which they carry off accumulate and decompose, and where disinfectants and ventilation are alike inapplicable.

Again, how is mortar—at least as used by the London building speculator—composed at present? Not as it used to be, and as it ought, of sand and lime. In any suburban region the surface-soil—it may be that of a recent market-garden, highly manured—is made to do duty for the former! What of the beams, the flooring, and other wood-work in the semi-detached villas and "desirable residences" advertised as to be let or sold? Is it fresh, wholesome timber from Norway or Canada? No; houses in the slums, which may have been inhabited by successive generations of diseased

and filthy inhabitants, are pulled down, and their woodwork, after being slightly dressed over, is used in the erection of new, pretentious, and highly-rented structures. Whether such wood is or is not saturated with the poison of small-pox, of scarlet fever, or of typhus, the building speculator never cares, and the purchaser or the tenant has no means of knowing. These evils cannot be illustrated in any Exhibition. If they could it would make a far stronger impression than any lectures, articles, or letters.

From the sins of the builder we may pass to those of the tailor, the modiste, and the shoemaker. Here, again, is much that cannot be exhibited. Charles Kingsley told us, and modern authorities have enforced the sad tale, how the superfine garments which Society buys at some fashionable establishment have been made in the den of some sweater, reeking with disease; may even, whilst unfinished, serve to cover the bed of the dying, and may thus convey infection to their wearers. How could such grim facts be brought clearly home to the public?

Some of the effects of tight lacing and of high-heeled boots might be rendered palpable by means of anatomical models; but if this has been done in the present display it has so far escaped our detection.

We miss likewise any attempt to familiarise the public mind with cremation as a means of disposing of the dead. A display of the gas-furnace contrived for this purpose, and an occasional demonstration of the rapid and inoffensive manner in which nitrogenous matter is thus decomposed, would have been useful.

The greatest cause of the debility of these days—the influence of worry and overwork under the pressure of anxiety—cannot be exhibited, and if it could be we doubt if the exposure would be sanctioned.

The entire Exhibition, as a matter of course, has not been collected on the principle of displaying all the various causes which tend to undermine human health and vigour, and the devices which have been hitherto adopted for their removal. It is a promiscuous gathering of whatsoever articles can be looked on as connected with health, and its central idea seems to be that of advertising.

ANALYSES OF BOOKS.

A Dozen Papers relating to Disease Prevention. By CORNELIUS B. FOX, M.D., F.R.C.P. Lond. London: J. and A. Churchill.

THE first of these papers discusses a subject of manifest national importance—the "Impairment of the Efficiency of the Medical Officer of Health produced by his want of Independence as a Public Official." That such an impairment must occur might well be admitted *à priori*, but the author adduces facts by which it is superabundantly proved. If the medical officer is a general practitioner, he cannot do his duty without giving offence, and thus losing his patients. If he advises houses to be closed as unfit for human habitation, or if he condemns meat, &c., in the market as dangerous to health, powerful local interests are aroused against him.

Dr. Fox denounces the Public Health Act of 1872 as radically unsound, "attaching as it did public health to poor-law work." Here he is perfectly right. The average poor-law guardian in England, and, we fear, still more in Ireland, is a half-educated being, who knows nothing of sanitary matters and does not care to learn. But if the medical officer is not in practice, but receives from a combination of districts a salary which might make it worth his while to give his whole time to his duties, he is scarcely in a better position. If he tells the truth, the district which he denounces threatens to withdraw from the combination—as the law unfortunately permits it to do. He has thus no tenure of his office, and unless he is prepared to sacrifice himself for the good of the public, his obvious policy is to shut his eyes, issue delusive reports, and—quietly draw his salary.

Much of what Dr. Fox here says we can confirm from our own observation. We know cases where the medical officers of health of considerable districts receive mere nominal salaries. They have been appointed as a mere nominal compliance with the law, with the express understanding that they should do nothing!

The paper on "Coke as a Fuel in relation to Hygiene" is the more important, as what is said applies equally to anthracite, which has been unduly extolled as a means of getting rid of the smoke-nuisance. The public labour under the error of supposing that the chief evil of smoke is the visible blackness. Admitting the unpleasantness of soot-flakes, we must still maintain that its worst features are unseen,—sulphurous acid and carbon monoxide,

formerly known as carbonic oxide. This gas, as Dr. Fox shows, is a fearful poison ; it is produced during the combustion of coke, and it permeates heated cast-iron. It is a strange thing that we cannot in this country obtain stoves of glazed earthenware, and thus economise fuel without inhaling a narcotic poison. The author remarks that "the sun, burning coal, burning wood, hot-water pipes, and stoves, give forth heating rays which can by some be distinguished in virtue of a difference in the impressions afforded." That such should be the case is, theoretically speaking, to be expected, but we fear that few persons could be found sufficiently sensitive for the study of these variations. Perhaps experimentation on plants or on certain insects might show whether there is any difference in the physiological action of heat obtained from difference sources.

In an essay on the supply of rain-water to cottages in rural districts, Dr. Fox combats the arguments brought forward on behalf of hard water as a domestic supply. He quotes Dr. Cameron to show that the death-rates of Glasgow and Manchester, and other towns supplied with soft water, were not lower when the water furnished to them was hard, and that the public health of Dublin has improved since the substitution of the soft water from the Vartry for the hard-water with which that city was formerly provided. Dr. Fox's own experience leads him to the conclusion that a water of moderate hardness is preferable to either a very soft or a very hard water, and that a very soft water is preferable to a very hard one.

On the pollution of rivers, Dr. Fox takes a view mid-way between the advocacy of neglect and the sensational and impracticable policy of the defunct Royal Rivers' Pollution Commission. He quotes, approvingly, the dictum of the Duke of Somerset—"The foul matters encumbering streams may be got rid of, but the notion of their supplying water fit to drink must be altogether put aside." For our own part we have very rarely found the water of a lowland river fit to drink, even in uninhabited and uncultivated districts.

Concerning the degree in which various kinds of fish are affected by polluted waters there is much diversity of opinion. The author states in a note that "the gudgeon is said to be more liable than any other fish to be influenced deleteriously by impure water." We have heard the same view expressed in other quarters. Yet the late Frank Buckland, in his "Natural History of British Fishes," says that gudgeon are very fond of living in sewer water which would be immediately fatal to a trout or a salmon. Perhaps in reality the death of one species of fish, or the survival of another, depends more upon the kind than the mere quantity of the pollution.

Dr. Fox denounces, very justly, the common practice of depositing solid refuse on the banks of rivers where they may be carried off by floods. To this practice is due, to no small extent,

not merely the silting up of streams formerly navigable, but the increase of floods—one of the many evils with which our farmers have to contend.

Two important papers, "Is Enteric Fever ever Spontaneously Generated?" and "The Dissemination of Zymotic Disease among the Public by Tradespeople," suggest reflections not altogether pleasant. It must be admitted that we have in these enlightened days agencies for the transmission of infectious diseases unknown to our forefathers. Our public conveyances, our loan libraries, our distribution of tracts and circulars, and (if we may presume to utter such heresy) our School Boards, are all admirable devices for this purpose. It seems that according to the existing law a shop or a publichouse may remain open whilst there is zymotic disease on the premises, and the very persons who nurse the sick may attend to customers. We remember being much shocked, about twenty years ago, at discovering that in a back room, separated from a shop merely by a curtain, there was a case of malignant typhus. But the facts stated by the author—far too many for us to quote—are, if possible, even worse. He has detected a dairyman washing out cans with "most offensive sewage-water," and milking his cows into a pail which resembled a filthy pigs' bucket. He asks why dairies cannot be placed under sanitary inspection as well as slaughter-houses? Why indeed?

We should strongly advise all who wish to have healthy homes to read Dr. Fox's little pamphlet. They will then see that as long as things remain in their present condition there is small cause to wonder if small pox, scarlet fever, and the like penetrate into families where, as far as is known, all the conditions of health are observed.

The Principles and Practice of Electric Lighting. By Alan A. Campbell Swinton. London: Longmans and Co.

This work, the author tells us, is intended to meet the wants of persons who use, or wish to use, the light, and of "the general scientific public who take an interest in all new discoveries and inventions." He avoids therefore, as far as possible, technicalities, and describes merely such machines and appliances as are of approved practical value.

After an Introduction, in which the apparently slow progress of electric lighting is discussed, Mr. Swinton considers the theory of electric lighting, and explains certain technical terms which are practically indispensable. He then proceeds to an account of electrical, mechanical, and photometrical measurements. The

Bunsen photometer is of course recommended as preferable to that of Rumford, but no standard unit is suggested as more constant than the English candle and the French carcel.

Among sources of power wind is omitted, doubtless from its inconstancy. In the fifth chapter, which treats of Dynamo-electric Generators, the most efficient machines of the day are described and figured. It is prophesied that the dynamos of the future, "though they may not be very much more efficient than those of the present day, will probably be of much larger size and of simpler construction"—a very safe forecast.

The two next chapters treat of Arc-lamps and of Semi-Incandescent and Incandescent Lamps, the advantages of the latter as best suited for use in houses and other confined areas. Their freedom from flickering is the most important point. According to Sir W. Thompson, for one and the same expenditure of power an arc-light gives ten times the quantity of light which can be obtained from a glow-lamp. In the latter the consumer has to steer his way between two evils. If the current is too powerful the filament is rendered intensely brilliant, and the economy of the light is increased. But the filament is soon worn out, and the lamp quickly becomes useless. If the current is too feeble the lamp will last for a very long time, but the light is feeble and yellow.

"Accumulators," as at present constructed, labour under so many defects that they are employed only where unavoidable. Probably they may be found capable of improvement. In the meantime they serve mainly as a type of the modern English youth whose education consists in preparing for examinations. The secondary battery, like the student, takes up a certain quantity of power, and gives it out again minus a heavy amount of leakage.

The last chapter is one of great practical importance, as it discusses the advantages and the cost of electric lighting. It is interesting to find that in several cases, the particulars of which are fully known, electricity has proved itself a cheaper source of light than coal-gas. The installation which Mr. W. Crookes, F.R.S., has adopted in his house, for the efficiency of which we can bear witness, effects a saving of £4 17*s*. 6*d*. yearly, although the dynamo and the gas engine, from the nature of the case, work under serious disadvantages. An important consideration is that incandescent lamps do not vitiate the air in the slightest. Ceilings are not blackened; books, pictures, upholstery are not injured, and the risk of fire is decreased.

We think that this little book will encourage many persons to try the experiment of introducing the electric light into their houses, and will thus do a good work.

Thoughts on the Interdependence of Water and Electricity, and Cognate Subjects. By WILLIAM BOGGETT. London: Ridgway.

IF Mr. Boggett is right our physics and our chemistry will have to be re-constituted, almost from the very beginning. Electricity, we are told, is not a form of energy, but a kind of matter. Water is a compound, not of hydrogen and oxygen alone, but of these *plus* electricity. Such assertions could only be established by very definite experimental evidence. Such evidence the author does not, as we understand him, bring forward. He writes:—"It is inconceivable that any mere *mixture* of two combustible and explosive gases could remain unconsumed when exposed to intense heat, or, if water is composed of them without any other admixture, that the hottest fires could be extinguished by their use." Precisely so; but no chemist contends that water is a *mixture* of oxygen and hydrogen, but a combination, which is quite a different thing. Further, oxygen, *per se*, is neither combustible nor explosive. He writes further, "there is no proof that electricity is *not* in water." This is a perfectly illegitimate line of argument.

We read further:—"As ice floats upon it [water], and consequently is lighter than water, it must have lost some ponderable matter. It had parted with its oxygen, that being eight times heavier than the hydrogen, and likewise with the electricity, which is not present in ice." Here the reader will perceive a collection of errors. Ice is specifically lighter than water, and floats upon it just as solid tin floats upon melted tin—not because it has lost any ponderable matter, but because it has expanded during freezing. The proof of such expansion is known to every one. If water loses ponderable matter in freezing, then a pound of water, if converted into ice, would weigh less than a pound, which has never been observed. The author, further, if we understand him aright, says that water in freezing parts with its oxygen,—an assertion perfectly unsupported by experiments. Had it done so it would not become ice.

Mr. Boggett contends that water is necessary to the production of an electric current. What, then, of the thermo-electric battery, and of the dynamo-machine, now recognised as the most economical source of electricity?

We by no means assert that the orthodoxies of Science are placed beyond question. But whoever comes forward to refute them should at least have given them a careful study, and understand clearly what he is attacking. Now the author formally admits that he knows "next to nothing of chemistry."

Vichy and its Therapeutical Resources. By PROSSER JAMES, M.D., M.R.C.P. Fifth Edition. Baillière, Tindall, and Cox.

THIS pamphlet presents little to attract the especial notice of our readers. It gives a description of the Vichy springs, their origin, and the history of the Spa. The account of the neighbourhood is flavoured with a *soupçon* of satire :—"Our Continental friends have either an excessively keen eye for the beautiful, as well as the curious and rare, or a very poor opinion of John Bull's judgment, for they never fail to find something for him to see, and, having seen, to pay for. A house in which some one was born, or died; a ruin which may have been a castle, or may not; a convent, a church,—anything, in short, which can be seen is called a sight, and serves the purpose of extracting a franc from the purse of the credulous traveller."

Next follows a chemical analysis of the waters, which it appears all contain a modicum of arsenic. The present rage for mineral waters—all we believe imported—shows what may be done by persistent advertising. The life-pills led the way and the waters followed.

Vestiges of the Natural History of Creation. By ROBERT CHAMBERS, LL.D. Twelfth Edition, with an Introduction relating to the authorship of the work by ALEXANDER IRELAND. London and Edinburgh: W. and R. Chambers.

IT is hard for men still on the sunny side of their fortieth year to realise the outcry which greeted the first edition of the "Vestiges." It is harder still for those who are now waxing old to look back upon that outcry without a feeling of deep humiliation—shame for our country and shame for our boasted and boastful nineteenth century. For the part taken in this tumult by the churches—the so-called religious world—there was, indeed, slight and scanty cause. For the book denounced, when viewed by men in their sober senses, is found to be, alike in its line of argument, its purpose, and its very title, plainly theistic and at issue with no point of the creeds of Christianity.

But the conduct of a great part of the scientific world of the day is even more to be deplored than is that of ecclesiastics. The late author said, as quoted in Mr. Ireland's introduction :—"I feel embarrassed in presenting myself in direct opposition to so many men possessing talent and information, but I think there are reasons *independent of judgment* for the scientific class

coming so generally to an adverse conclusion concerning my views. As the case really stands the ability of the purely scientific class to give at the present time a true response upon such a subject appears extremely challengable. It is no discredit to them that they are, almost without exception, engaged each in his own little department of science, and able to give little or no attention to other parts of that vast field. . . . Experiments in however narrow a walk, facts of whatever minuteness, make reputations in scientific societies; all beyond is regarded with suspicion and distrust. The consequence is that philosophy, as it exists among us at present, does nothing to raise its votaries above the common ideas of their time."

We fear, however, that much of the opposition which the teachings of the "Vestiges" met with from scientiffc men sprang, in part at least, from motives less creditable than a mere lack of the *esprit d'ensemble*. A novel theory put forward in an anonymous work, or by a man whose reputation is not already established, is, even in these days, by no means sure of a fair hearing. We fear that some of the scientific critics of the "Vestiges" were, in fact, hypocrites who, against better light and knowledge, pandered to ruling error. Upon this subject, however, we cannot enlarge.

The authorship of the work before us was at one time hotly contested. We learn, indeed, from the introduction that, though Robert Chambers was, among not a few others, suspected of being the author, yet "there is in existence an elaborate MS. essay demonstrating that he could not have been the author."

To undertake a review of the "Vestiges" would now be superfluous. Most of the arguments urged against it have been not merely shattered but decomposed, and, as the old alchemists used to say, resolved *in terram damnatam*. We may, however, briefly notice some of the points in which the "Vestiges" differs from the "Origin of Species,"—a difference, as we believe Mr. S. Butler would contend, not always in favour of the latter work. Darwin, as is well known, does not speculate on the primary origin of life. He seeks merely to show how from one or from few species the present rich diversity of the animal and vegetable worlds may have been developed. Chambers argues in favour of spontaneous generation (abiogenesis) as not improbable. It must be admitted that the evidence here brought forward in its behalf is not in accordance with the knowledge of the present day.

In Chambers we find no trace of "Natural Selection" and "Sexual Selection" as agents in the work of Evolution. On the contrary, this development is, in his opinion, the result—"First of an impulse which has been imparted to the forms of life, advancing them, in definite times, by generation, through grades of organisation, terminating in the highest dicotyledons and vertebrata, these grades being *few in number*, and generally

marked by intervals of organic character which we find to be a practical difficulty in ascertaining affinities; *second*, of another impulse connected with the vital forces, tending, in the course of generations, to modify organic structures in accordance with external circumstances, as food, the nature of the habitat, and meteoric agencies, these being the 'adaptations' of the natural theologians."

The difference of this scheme from that of Darwin is capital. With the latter change is constantly going on by insensible degrees, those results only being preserved which prove advantageous to the plant or animal concerned. With Chambers the grades are few in number and, as it appears from an illustration, occur only at long intervals.

It must be further remarked that Chambers, whilst admitting the modifying influence of circumstances, does not accept the theory of Lamarck, that the animal, by constant desire and effort, modifies, if not its own individual structure yet that of its race, and is thus its own contriver and adapter. This view Chambers pronounces "so far from being adequate to account for the facts that it has had scarcely a single adherent."

In our estimate of the "Vestiges" we must not forget that its author overleaps at once the fancied barrier at which Darwin so long hesitated, and recognises that "the force and tendencies of their (man's) illustrious nature once lay imperfectly developed in some humbler form of being."

Chambers's sketch of the affinities and pedigrees of animals contains much which, we may safely say, would not have been written in these days. His somewhat favourable estimate of the taxonomy of Macleay and Swainson seems strange in thsee days.

The "Vestiges" have now, indeed, it may be said, a merely historical interest, but to the thorough-going student of Evolution they will never seem unworthy of attention. We must therefore rejoice at the appearance of the present edition, the more as it clears up all doubt as to the authorship of this once dreaded volume.

Compulsory Vaccination in England with Incidental References to Foreign States. By William Tebb. London: E. W. Allen.

The difficulty of coming to a final decision on vaccination is greatly to be regretted—the more since, behind the simple question of vaccination as a preventive of variola, lies the further question of "vaccinations," if we so use the word, for other zymotic diseases. If Jenner has been a false teacher we fear that Pasteur also is labouring in vain. Hence the issue is one

of scarcely conceivable importance to the human race, and its discussion should, we submit, be conducted in the pure white light of the intellect alone, without appeals to the passions. In this respect we note with little satisfaction a quotation from Mr. John Morley that "when the law comes into conflict with the consciences of men it is law that should be altered, and not the conscience that should be forced." To this dictum we cannot give our assent. There is such a thing as the conscience of a Thug, or of an Inquisitor. Yet the law is bound to "force" these consciences, and to uphold its interference, if needful, with the rope or the bullet. In like manner if it is once demonstrated that vaccination is a sure preventive against smallpox, and that it does not bring in its train any other evils, the person who refuses to avail himself of it, and thus makes his household a focus of danger for the community, not only may but should be "forced," all pleas of conscience notwithstanding. The whole question, then, is simply physical, and should be treated as such.

Unfortunately it cannot be denied that the opinion of the Faculty as to the certainty and the duration of the immunity obtained by this "Parliamentary rite," as Mr. Tebb calls it, has changed. Time was when vaccination once, in infancy, was deemed a sufficient protection for life. Then it was found desirable to repeat the operation at the age of puberty. Now it is recommended in addition whenever an epidemic of smallpox breaks out, and Dr. Collingridge, of the Port of London, is here quoted as recommending "thoroughly efficient *annual* vaccination." These proposals are an evident admission that the protection is neither absolute nor enduring.

The statistics given in the work before us are sufficiently alarming, and cannot be thoroughly discussed without a reference to documents which we have not at command. Certain considerations on the other side, however, suggest themselves. We are here told that the mortality from syphilis during the years 1850 to 1880 has increased from 37 per million to 84, or 124 per cent. This fact is given in evidence of the hazardous nature of vaccination. Now, that this operation has transmitted constitutional syphilis from the diseased to the sound we admit. But is it the only cause for the increase? And how is it that so many anti-vaccinators are at the same time unwilling that any measures for the eradication or the restriction of syphilis should be adopted? Why do they nickname endeavours in this direction "State regulation of vice?"

Again, let us take the cases where various other diseases have broken out, in children or in adults, after vaccination, and on the *post hoc ergo propter hoc* system are ascribed to this operation. Few persons like to confess themselves scrophulous, syphilitic, &c., and vaccination often—though by no means in all cases—serves as a convenient explanation for the occurrence of these diseases in their children. The fact must be admitted that

diseases of debility are undermining our stamina as a race, and unless we are found willing to modify our mad industrialism, and especially our love for competition in education, we shall ultimately succeed in "improving ourselves off the face of the earth."

To return: every right-thinking man must, we believe, feel indignant on learning that children born in work-houses, "when six days old," and even when twenty-four hours old, are often vaccinated. Nor can the compulsory re-vaccination of recruits on entering the army, or of candidates for employment in the Post Office, the police force, &c., be justified. With singular caprice, in the Inland Revenue Department, "the advantages of compulsory re-vaccination are reserved for the inferior and junior servants of a particular department," to wit, the stamping-room boys. Mr. Tebb remarks: "Surely the older servants and chiefs of the Department have more need of a renewal of the prophylactic than the stamping-room boys, whose vaccination, it may be presumed, is of comparatively recent date."

One feature in this work against which we must record our protest is the intimation, repeatedly met with in its pages, that medical practitioners, in upholding vaccination, are to no small degree influenced by the fees which they receive (see pp. 16, 56, 63). Yet a medical officer of health, quoted by Dr. Fox in a work reviewed in our present number, said: "The public cannot expect that I, who receive from them for my public services next to nothing, should do my best to prevent the extension of so *remunerative a disease* as smallpox, every case of which I consider, taking the average of fees obtained from rich and poor, to be worth to me a £5 note." Surely this is the view that a mercenary medical man would naturally take.

Proceedings of the Literary and Philosophical Society of Liverpool during the Seventy-second Session, 1882-83. No. XXXVII. London: Longmans and Co. Liverpool: D. Marples and Co., Limited.

In these "Proceedings" we find abstracts of a few interesting papers which have not been thought worthy of publication in full. Especial mention must be made of a notice by Mr. E. Dukinfield Jones, C.E., on the remarkable drinking habit of a yellow and black Brazilian moth (*Panthra pardalaria*). The author found these moths sitting on the wet stones in small streams near San Paulo, sucking up the water in a continuous stream, and letting it escape in drops from the abdomen. These

drops fell at the average rate of 50 per minute, and as near as the author could judge of their size, the total quantity of water which must thus pass through the body of the moth in three hours must be a cubic inch, or about two hundred times the bulk of its own body. Mr. Jones speculates on the possible meaning of this dipsomania, and asks—"Can it be that the moth extracts nourishment from minute particles of organic matter contained in the water?" He remarks, however, that the water of the streams appears very clear and pure, and notes that the moths seem specially adapted for this habit. The tibiæ of the hind legs are very thick, and are armed with long hairs, which by their capillary action prevent the moth being immersed in the water. "I have often," he adds, "seen one of them knocked down by a little spurt of water splashing over the stone on which it was standing, and it recovered itself almost immediately without being wetted in the least."

Mr. Jones also contributes a paper on the question "Do Birds Eat Butterflies?" which is one of great interest as bearing upon the question of mimicry. He writes—"During the whole of my residence in Brazil, amounting in all to eight years and a-half, I cannot call to mind a single case of a bird that habitually devours butterflies, though I may have, now and then, seen a scissor-bird snap at a passing one, as we sometimes see our English sparrows do. But my opinion is that birds do not devour butterflies to an extent at all sufficient to account for a protective colouration of their wings through the action of natural selection."

Since writing our notice of Mr. Pascoe's "Notes on Natural Selection" we have questioned several old gardeners on the subject, but we have found none of them prepared to assert positively that any species of British bird does habitually prey upon butterflies. They had all, from time to time, seen a sparrow chasing a butterfly, and occasionally striking it down; but they could not distinctly state that the victim was eaten! The Old School were wont to tell us that the final cause of the wavering flight of butterflies was for their protection against birds.

Among the papers inserted *in extenso* we notice one by Mr. E. Davies, F.C.S., the President, "On the Unity of Life." The author insists ably on the absence of any tenable boundary between plants and animals, and is even, like ourselves, willing to admit that living vegetable protoplasm may possess "a dim consciousness of external influences with a corresponding measure of pleasure or pain." At the same time he finds between living and non-living matter a difference not of degree but of kind.

Our Corner. Vols. I. and II., 1883, and Parts 1, 2, 3, 4, 5, 1884. London: Freethought Publishing Company.

A VERY large portion of this heterodox contemporary consists of matter lying quite outside the sphere of the "Journal of Science." There are, however, valuable articles connected with science. Thus in the first volume we find Prof. L. Buchner discussing the "Force of Heredity," and its influence on the moral and mental progress of mankind. Here, whilst it is admitted that Darwin was the first fully and clearly to point out the importance of heredity, the merits of Girou de Buzaraingues, of Prosper Lukas ("Traité Physiologique et Philosophique de l'Hérédité Naturelle"), and of George Leroy, are brought into deserved prominence. The capital dictum of Burdach is also quoted, that "Descent has more influence on our bodily and mental character than all our external, material, and psychical surroundings." Many suggestive instances of the working of the principle are given. Not the least important is the case of a cock born with the abnormal number of five toes instead of four. This bird left behind him a numerous progeny of five-toed fowls. This incident refutes the argument put forward by the "Edinburgh Review" against Darwin to the effect that any modification cropping up in some individual plant or animal would be effaced by mating with normal individuals. Prof. Buchner's memoir is not, as far as we can find, concluded, and it is therefore scarcely fair to call attention to omissions. Still it is impossible to overlook the absence of all reference to the gainsayers of the doctrine of heredity. These persons are to be found not, as is commonly supposed, among ecclesiastics, but among politicians—angry at being told that they cannot mould men at will by franchises, constitutions, and schemes of compulsory education. Of these "talkers of talk" the most vehement and absurd was John Stuart Mill, who, reared upon words, could digest things, and who even sought to defend the old-world predominance of "the classics" in education as against science.

"Peeps through the Microscope" is an interesting series of articles by Mrs. Annie Besant, the editor, and will we think win new votaries for research into the tiny features of plant and animal life.

"Angling Memories of the Lea" is a brief but pleasant paper by one whom we should certainly not have suspected of being an observer of Nature, to wit, Mr. C. Bradlaugh, M.P. "Leaves and Trees" is a study by the same writer, and though it does not fall within the exact limits of any science we have read it with much pleasure.

"Alter Brown" gives an apparent case of clairvoyance by which he was at first deceived, but which was afterwards explained in a very matter of fact way. The clairvoyante, one

Elizabeth Marsden, saw, in trance, cinnamon in the stomach of a certain patient who had been advised by his physician to eschew all spices. It turned out afterwards that this young lady had learned the doctor's orders, and had seen the cinnamon being grated into a rice pudding for the patient's dinner.

"Science Corner" is a collection of novel facts compiled by Mrs. Besant.

Mr. C. T. Bingham writes on "Bird Architecture" and "Strange Nests." He points out an error in detail in one of the zoological galleries at the British Museum. The jays are not merely badly stuffed, but their nests are "fixed in the forks of naked branches glaringly unconcealed." This the writer justly pronounces contrary alike to observation and to the well-known character of the bird. But Mr. Bingham points out, in addition, an error in principle:—"As for any knowledge to be obtained of the course evolution has taken in the development of their forms, a visit to the British Museum, and, as far as I know, to any museum, is quite in vain."

Mr. J. Horner discusses caves and their formation, and the cave men by whom they were once inhabited. As might naturally be anticipated, he does not accept the eager pleadings of Principal Dawson for a term of six or seven thousand years as the extreme limit of the existence of man.

In the February, March, and April parts of Vol. III., Dr. E. B. Aveling—who seems equally at home in biology and in dramatic criticism—discusses, with unquestionable ability, the relations betweeen flowers and insects, a subject on which the last word has by no means yet been said.

Almost the only point which we disapprove of in "Our Corner," limiting ourselves of course to questions upon which we are free and competent to express an opinion, is the question of higher education. We find here no word condemnatory of cram and examinationism, and of bureaucracy in science.

CORRESPONDENCE.

*** The Editor does not hold himself responsible for statements of facts or opinions expressed in Correspondence, or in Articles bearing the signature of their respective authors.

HANDKERCHIEFS PIERCED BY GROWING GRASS.

Early in April this year my attention was called to a row of five or six fine lawn handkerchiefs spread upon the closely-mown turf for the purpose of being bleached. They had been on the grass for five days, during which occured a remarkable change from cold and dry weather to a very showery time with almost unnatural heat. All the handkerchiefs were pierced by the points of the upspringing blades of grass; one of them had more than twenty points appearing, some of which had grown 2 inches above the handkerchief. I could see that many blades were bent back, and could not pierce the texture,—probably those which had truncated tips. On lifting the handkerchiefs no holes were discernible, even with the aid of a lens. The experiment has been repeated, under less favourable conditions, with partial success. In referring to the above observation, at a meeting of the Literary and Philosophical Society of Liverpool, my friend Dr. Carter illustrated the fact that in the piercing of stiff clay by the young shoot from a leguminous seed, the part in advance is not the leading cells, but the apse of the loop made by the stem. The question of chief interest to be investigated in the handkerchief experiment is the mode of connection between the parts of the blade below and above the fine lawn tissue which exhibited no marks of having been pierced.

Henry H. Higgins.

THE ENGLISH SYSTEM OF HIGHER EDUCATION.

Allow me to suggest a practical method by which your views, and those of certain of your correspondents on scientific and technical education, can be tested. Let returns be obtained (it can only be done with the consent of Government) of (*a*) the number of aliens employed in the United Kingdom as chemists,

engineers, designers, &c.; (*b*) the number of British subjects employed in similar positions abroad: (*a*) the number of aliens holding curatorships, professorships, &c., in British universities, colleges, museums, &c.; (*b*) the number of British subjects filling similar posts abroad: (*a*) the number of British subjects studying at foreign universities, &c.; (*b*) the number of aliens studying at British universities, &c.

If, when these returns are obtained, the values *a* are found to be comparatively large and increasing, whilst *b* are small and decreasing, then Professor Galloway is right, and the Committee of Council on Education, with its appendage the Department of Science and Art, is wrong. If *a* is relatively small and decreasing, then Prof. Galloway is mistaken.

As one crumb of fact I may mention that in the year 1858 there was in the Lancashire alkali district *one* foreign chemist employed. Now it would be easy to count up a dozen!

LOOKER-ON.

A PLEA FOR CRAM.

THOUGH you are the persistent and indefatigable opponent of the English system of education, your well-known candour will, I think, induce you to give space to the following considerations:—It often happens, in various walks of professional life, that a man has to get up a subject for some particular occasion, and that at a very short notice. He is not required to produce any original research on the subject, but merely to have at his command a fair summary of the present state of human knowledge in that department. When the occasion is over he may never want this information again, and if he forgets it he is therefore no loser.

Now if a considerable part of a man's education has consisted in qualifying himself for examinations, and in passing them, he will, I think, find the task easier and more congenial than if his early training had, as you recommend and as the Germans seem to practise, consisted in qualifying himself for profound original research.

E. L. N.

NOTES.

The notices in the various newspapers of the "Giant Electric Microscope" at the Crystal Palace are amusing. All of them seem charmed with the enormous magnifying power of the instrument: that the eye of a small sewing needle can be enlarged to the apparent dimensions of 6 feet by 4 is evidently to these critics a performance surpassing that of any microscope yet constructed, and doubtless wonderful enough to those unfamiliar with the performance of the instruments commonly used by microscopists. Magnifying power alone has long ceased to be the great desideratum with workers; if everything else is sacrificed there is very little limit in this direction, provided light can be found to render the enlarged image brilliant enough to be seen. Definition is quite another thing: this taxes the skill of the optician to the utmost, and demands the most exact correction of the aberrations; great perfection has been reached, and the modern microscope has already accomplished that which theory formerly declared to be impossible. With regard to images thrown upon a screen very good definition is attainable; when a large surface is not required to be covered the fine quality of the numerous representations of microscopic objects by photography affords ample proof of what has been done,—all that the best microscopes can render visible has under certain conditions been faithfully reproduced. The delineations of the *supposed* minute markings on insect scales and diatom valves are marvellous, surpassing anything that the human hand can depict. Unfortunately, however, when the amplification is increased to an amount sufficient to render minute objects visible to a large audience, definition breaks down altogether, and only an enlarged image, of which the minute details are badly or not at all rendered, remains. The late Andrew Ross endeavoured to improve the definition of the projection microscope, but obtained no very good result. At present the only way of exhibiting a microscopic object on a screen in a satisfactory manner is to enlarge a photo-micrograph by means of a good magic-lantern; admirable results are obtained by this indirect method, while the direct projection of the magnified image of a minute object is at the present time a desideratum. The "Giant," so far as investigation is concerned, can be surpassed by a pigmy in the shape of a good pocket lens.

M. E. L. Trouvelot considers that the rings of Saturn cannot, on account of their changes of form, be regarded as solid bodies.

The hypothesis that these rings are composed of a multitude of small satellites describing independent orbits around the centre of gravity of the planet explains the phenomena observed much better.

A. Arès ("Ciel et Terre") contends that the red colour of Mars is due not to its soil or its vegetation, but to its atmosphere.

According to the "Journal d'Hygiene" citric acid is a most powerful disinfectant, preserving meat from putrefaction, and proving rapidly fatal to septic microbia. The soluble citrates have no similar action.

M. Poincairé ("Comptes Rendus") contends that the attraction of the moon modifies the intensity of gravitation. Hence at the Equator the clock is retarded by half a second yearly by the combined attraction of the sun and moon, and advanced a second at the Poles.

The inhabitants of Chiloe use as a weather-indicator the shell of a crab of the family *Anomura*, belonging probably to the genus *Lithodes*. It is almost white in fine weather, becomes covered with small red spots on the approach of moisture, and is almost entirely red when rain actually falls ("Ciel et Terre").

Mr. Maxwell Hall ("Monthly Notices of the Royal Astronomical Society") gives the following remarkable sequence of colour in the planets from the Earth outwards:—*Mars*, reddish; *Jupiter*, a delicate orange; *Saturn*, greenish yellow; *Uranus*, light green; and *Neptune*, slightly blue.

M. Faye ("Comptes Rendus"), after a careful examination, decides that the cosmogenic theory of Kant has not the smallest analogy with that of Laplace.

M. Milne-Edwards gives an account of a young male gorilla living at present in the Jardin des Plantes. This animal is savage and morose, taking no part in the sports of the other apes, and being apparently inferior in intelligence even to the gibbons.

M. J. Thoulet finds that the spiculæ of living sponges consist of pure silica.

Since the practical suspension of the "Infectious Diseases Act," effected by Mr. Stansfeld's motion last year, the number of syphilitic cases in the military hospital at Colchester have increased 300 per cent.

At a meeting of the Washington Biological Society ("Science") Mr. H. W. Elliott proved that the musk-rat (*Faber zibethicus*) is zoophagous, and preys largely on carp.

M. C. Barthelemy ("Comptes Rendus"), having placed a number of hyacinths in glasses in a circle around the pipe of a stove, found that the roots took an almost horizontal direction towards the pipe, as a common centre of attraction.

M. Legrand du Saulle ("Medical Press and Circular") notes the increase of insanity in France, which he ascribes to the thirst for enjoyment, the passion for riches, the risks on the Exchange (in other words to worry), and above all to alcoholism.

[Fully admitting the increase of alcoholism in France, we may still ask whether it, too, is not to a great extent due to worry?)

The 500th anniversary of the foundation of the University of Heidelberg will shortly be celebrated. The sum of £8000 has been voted by the Baden Parliament to defray the expenses.

P. Rosenbach has found experimentally that potassium bromide diminishes the sensibility of the cortical substance of the cerebrum to electric excitement, whilst the excitability of the underlying white substance remains unaltered.

P. Hende announces the existence in Corea of a small ruminant of the genus *Hydropotes*, differing from the *H. inermis* of Swinhoe, both by its cranial characters and by the lighter colour of its coat.

Four species of fossil reptiles, of the genus *Simædosaurus*, have been recently discovered in the neighbourhood of Rheims.

Mr. David Hooper, F.C.S., of Birmingham, has been appointed, by the Secretary of State for India, Analytical Chemist and Quinologist to the Nilgiri Government Cinchona Plantations in the Madras Presidency.

[A learned contemporary states that Mr. Hooper has been appointed "Analogist" to the Plantations.

Mr. J. P. Joule, the illustrious physicist, speaking of Dr. Bardsley's proposal to stamp out hydrophobia by keeping all dogs isolated for four months, says:—"It is difficult to understand the intellectual and moral condition of a public which, by the neglect of this obvious precaution, consigns to a frightful death probably as large a number of persons as those who by common custom are exclusively spoken of as murdered."

It appears that there are now, in London, three distinct Spiritualist associations, two Theosophic societies,—one of which, the "Hermetic Lodge," includes not a few prominent Bestiarians,—besides the Society for Psychical Research, in which, according to "Light," the "veriest agnostic may find rest for the sole of his foot, and wonder how he came there."

According to a letter which the "Medical Press" quotes from the "Madras Courier" of 1819, inoculation for smallpox, and

probably also vaccination, were practised in India in very ancient times.

Prof. Virchow, in a speech delivered at the recent Edinburgh Tercentenary, remarked that his opinions on Evolution have been much misunderstood. "I never was hostile to Darwin,—never have said that Darwinism was a scientific impossibility."

A species of rice has been discovered in Mantchuria which can be cultivated without irrigation, and consequently without risk to the health of the district. Whether it is equally productive with the common species remains an open question.

Mr. W. M. Flinders Petrie finds proofs that the ancient Egyptians cut their hard building-materials, such as diorite, granite, basalt, &c., by means of instruments pointed or edged with diamonds or sapphires.

Mr. Mallard Reade, writing in the "Geological Magazine," calls attention to the fact that South Georgia, though 1200 miles from the nearest continent, and therefore entitled to be called an "oceanic" island, is composed of clay-slate. This fact, he considers, "strikes a vital [? deadly] blow" at the hypothesis of the permanency of oceans and continents. The mountains are from 2000 to 3000 metres high, and no land-mammals were found on the island.

"Ciel et Terre," on the authority of Caillie, raises the question whether swallows, of the same species as those which visit Europe, do not remain in Africa during the breeding-season.

Some years ago we called attention to the sanitary legislation of the Pentateuch, as being in many points in advance of our modern practice. We now learn that, according to the law of Buddha, should a man or woman unwittingly marry into a family afflicted with hereditary disease, such as leprosy, cancer, syphilis, madness, &c., he or she may sue out a divorce. According to the "Medical Press" Buddhists are taught to believe that not only will the children of diseased parents inherit a transmissible disease, but that the husband or wife will contract the same by association.

The "American Naturalist" lays down ten commandments for scientific men. We quote one of them :—"Thou shalt not fall into the snare of the devil, and believe thou wilt wax great by the making of long names to torment thy people."

We hear rumours that Prof. Flower finds himself interfered with in his management of the Natural History portion of the British Museum, by intrigues emanating from a well-known quarter.

It is a curious fact that whilst *Helota Africana* is found in

Angola, all the other species of the genus occur exclusively in Eastern Asia.

We regret to put on record the death of Sir Sidney Saunders, a Vice-President of the Entomological Society. The deceased was an accurate and thorough-going investigator, and is well known for his researches on the metamorphoses of the Cantharidæ, and on the internal parasites of the fig.

Dr. Donovan ("Medical Press and Circular") drily remarks that the Right Hon. A. Mundella may be thoroughly competent to frame laws having regard to the Nottingham stocking-trade, but that the manufacture of stockings does not render that estimable gentleman an infallible authority on medical reform. (Surely Dr. Donovan must know that a Privy Councillor is simply, as such, an infallible authority on all questions, scientific, literary, artistic as well as practical, and that if so inclined he may be elected F.R.S. almost as a matter of course.)

The Rev. Canon Curteis ("Nineteenth Century"), criticising Mr. Herbert Spencer, asks "Why should human dreams produce a religion, and bestial dreams produce none?" Is he sure that the latter produce none?

We are sorry to notice the death of Dr. R. Angus Smith, formerly assistant to Dalton, and latterly Chief Inspector under the Alkali Act. It will not be easy to find anyone who can administer this Act so satisfactorily, and at the same time with so little injury to the interests involved.

Almost at the same time died Prof. C. Wurtz, Professor of Chemistry at the Paris Faculty of Medicine, and at the Sorbonne. His death will leave Prof. Berthelot almost as supreme in the chemical department of the Academy of Sciences as is Prof. Milne-Edwards in the biological sphere.

According to Eugene Bonnemère ("Light") Zoroaster rejected asceticism and condemned the so-called virtues of monks.

The "Sporting and Dramatic News" (Saul among the Prophets?) has begun to publish cases of the fulfilment, or almost fulfilment, of several dreams.

Dr. C. C. Abbott ("Science") concludes that hybernation is a happy faculty which certain animals possess, but do not willingly exercise, as long as the temperature is sufficiently high and food is accessible.

M. Pasteur states that he "never could kill a bird for sport, though in the cause of Science he has no scruples." What a fine contrast to our anti-vivisectionist sportsmen!

It is announced that in October Sir W. Thomson will deliver a course of eighteen lectures on molecular dynamics, at the Johns Hopkins University.

Mr. Scott, in a paper recently read before the Meteorological Society, contended that the centigrade thermometer was invented not by Celsius, but by Linnæus, whilst Réaumur's scale is really due to De Luc.

A M. Ansart, writing in "Cosmos les Mondes," contends that "the Glacial epoch is the natural consequence of a miraculous, supernatural phenomenon, the *universal deluge.*

A bed of native coke is said to have been discovered at Las Cerillos, in Mexico, interposed between two strata of bituminous coal and of anthracite.

"M.A. (Oxon)," writing in "Light," denounces the "World" for the "fierce and bitter malignity" evinced in its recent article "Snobbery and Superstition."

M. Houzeau ("Ciel et Terre"), discussing the alleged satellite of Venus, argues that the body in question is a planet revolving at a small distance exterior to Venus, and that it is probably a satellite which has escaped from the control of its primary. He gives it the name of Neith.

The highest temperature registered in New South Wales in January last was 122° F. (50° C.)

According to the "Æsculapian" there prevails in the neighbourhood of Yakutsk an affection known as "miryachit." The patients behave very similarly to the "Jumpers" of Maine (*see* "Journal of Science," 1879, p. 247). The "Medical Press" considers that should the description of this nervous affection prove correct, it will go far to sweep away Heidenhain's explanation of hypnosis as a result of inhibition of the action of the higher nervous centres.

The Royal Commission on the discharge of sewage into the Thames state that "Nobody has hitherto anticipated that liquid discharged into the river at Barking could be transported many miles up the river in the face of the powerful descending stream of land-water; but that this effect is produced can no longer be doubted."

We learn from a medical contemporary that there exists a combined "Vigilance Association"—"an organisation of anti-vaccinationists, anti-vivisectionists, and anti-contagious-disease agitators," for the purpose of "blocking" any Bills brought into Parliament which may be hostile to the ends of these worthies. Have the medical and the scientific world not influence enough to organise a counter "Vigilance Association"?

According to the "Medical Press" Dr. Koch, in recognition of his researches into the origin of cholera, has received from the Reichstag the sum of £5000, and is nominated to the Crown Order of the second class. What a contrast to England!

Says our distinguished contemporary, "Science":—"Twelve years ago the thorough-going policy of the British Admiralty in fitting out the *Challenger* Expedition inspired us all with a hope that a new kind of governmental policy, in support of biological investigation was being inaugurated. American as well as English naturalists have therefore been greatly disappointed that, since the return of the *Challenger*, the British Government has done practically nothing to forward marine research. The economists of the Manchester school are still in the ascendant, and the study of animal life is evidently to be left, like fish-culture and the prediction of the weather, to private enterprise. (The rewards for biological research in England are the shrieks and vituperations of fanatics, and the possibility of fine and imprisonment.)

A movement has sprung up in Canada which deserves support. The Government has been requested to consider a naturalists' exchange post for Canada and the other countries within the postal union.

An *Isaria*, a fungus parasitic on *Bombyx rubi* (according to the "Kansas Review of Science"), in passing from one stage of its growth to another, not only changes from one species and genus to another, but actually overleaps the chasm that separates one family from another,—starting as a member of *Hyphomycetes*, and ending as a member of the *Ascomycetes*.

The remains of Prof. Gross, styled the "Nestor of American Surgery," have, according to his will, been cremated at the furnace erected at Philadelphia.

C. Sternberg ("Kansas Review of Science") declares the fossil Dakota flora a wonderful disproof of the theory of Natural Selection. He alleges that "the grand flora of the Dakota appeared with no intermediate species between it and the coal-plants of the carboniferous," and further that the cretaceous flora is "as perfect as any of the present day."

According to Prof. Riley *Pyrethrum* powder is poisonous to the higher animals as well as to the lower forms of life.

ERRATUM.—In our May issue, p. 296, line 19 from bottom, *for* Bates *read* Belt.

TWENTY-FIRST YEAR OF PUBLICATION.

THE

JOURNAL OF SCIENCE,

AND ANNALS OF

ASTRONOMY, BIOLOGY, GEOLOGY, INDUSTRIAL ARTS, MANUFACTURES, AND TECHNOLOGY.

(MONTHLY, FORMERLY "THE QUARTERLY JOURNAL OF SCIENCE.")

POST TENEBRAS LUX

Vol. VI. (Third Series)
No. CXXVII.

JULY
1884.

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LONDON:
3, HORSE-SHOE COURT, LUDGATE HILL.

Where Communications for the Editor and Books for Review may be addressed.

PRICE ONE SHILLING AND SIXPENCE.

THE

JOURNAL OF SCIENCE.

JULY, 1884.

I. THE DOMESTIC ANIMALS IN THE "PILE-DWELLINGS" OF THE BIEBR LAKE.

MUCH attention has been drawn of late years to the pre-historic remains discovered on the margins of certain lakes in Switzerland. Most of our readers will be perfectly aware that the shores of the lakes of Geneva and Neuchatel were once inhabited by a race of men who in many respects resembled the Dyaks of the Eastern Archipelago. As a means of security against enemies these extinct Swiss tribes drove piles into the lake bottoms in shallow parts, and on the summits of these constructed their huts. Like the Dyaks, further, they adhered to the same style of architecture, even in spots not overflown—constantly at least—with water. Whether this singular custom may be regarded as a "survival," proving man's ultimate descent from some tree-haunting animal, is a question which we cannot here discuss.

That the remains of these old dwellings have proved invaluable documents to the ethnologist need scarcely be insisted upon. But the zoologist—taking the word in its ordinary limited sense, as applied to one who studies the lower animals only as distinguished from man—is not less concerned. During the last ten years important drainage operations have been carried on at the Biebr Lake, which have permanently lowered its level and laid dry a considerable tract of country. Here, of course, a more extended and systematic exploration has been rendered possible than could be attempted on the shores and in the shallows of the

lakes of Geneva and Neuchatel. Besides artificial objects of various kinds, the bones of animals were collected and removed to the Museum of Berne. Here they have been carefully studied and arranged by M. Th. Studer. The results of his investigations, of which we give a brief abstract, may be found in detail in the "Transactions of the Berne Society of Naturalists" (1883, Part II., No. 1042).

From an examination of the artificial objects it appears that the different stations along the shores of the lake represent very different stages of civilisation. Arranged in the order of time we have Schaffis, Lattrigen, Lüscherz, Vinelz, and Möringen. M. de Fellenberg, who conducted the explorations on the Biebr Lake, gives the following sketch of the characteristics of these different stations:—

At Schaffis the production of implements of polished stone is only in its dawn, whilst fine tools of flint show the culminating point of the preceding epoch, the Palæolithic. In accordance with the character of the stone-articles, and of the objects of horn and bone, is that of the pottery, which is not to be distinguished from that of the Cave-dwellers, and represents the first attempt in fictile art.

Lattrigen and Lüscherz show a higher stage of culture. Here there is a profusion of objects of stone, horn, and bone, and a finish in their workmanship such as is met with in no other station in Switzerland. In certain branches of these manufactures we find marks of a kind of prosperity, and even luxury, which fix the date of this station as belonging to the later Palæolithic epoch.

Another station at Lüscherz, situate deeper in the lake, and that at Vinelz indicate further progress. Along with the stone and bone implements of the earlier epochs we find here stone hatchets, perforated to receive a handle, and thus giving the advantages of greater weight and of a double edge; or one side is to be used as an axe, and the other as a hammer. The most important step, however, is the use of metals, and in the first place of copper, which is applied to tools modelled exactly after those of stone.

Finally, at Möringer we find ourselves landed in the full development of the Bronze epoch. Tools of stone and bone are here completely superseded by manifold articles of bronze. The clumsy stone axe has given place to the bronze hatchet and the bronze sword. Prosperity is evinced by the numerous articles of personal decoration, armlets and anklets, &c. The frequent occurrence of grindstones, grain-crushers, grains of corn and bread, are signs of agricultural industry.

During this lapse of time, extending certainly over thousands of years, the animal world, and especially the domestic species, had passed through changes which M. Studer has investigated by means of the abundant material of the Berne Museum. His attention has been especially directed to the dog, swine, sheep, goat, ox, and horse, whilst the coeval wild animals are merely noticed in passing in the introduction to his memoir. The results are equally interesting from a zoological and from a historical point of view, and may thus be summarised :—

In Schaffis, the station representing the most primitive type of culture, we find, along with domestic animals, beasts of the chase in about equal numbers. Amongst these, furry species play a part much more prominent than in the pile-villages of more recent date. Among the tame animals there is little variety. The dog, the swine, the goat, the sheep, and the ox are represented each by a single homogeneous race. Not one of them has an endemic wild representative, from which we might conclude that it had been tamed on the spot. The dog is the small "peat-dog," very different from the wolf. The swine differs clearly from the wild boar, and the ox from the urus. Wild representatives of the forms *Capra* and *Ovis* were then as little known in the Swiss plain as at present.

As regards other pile-villages in Switzerland the same facts appear to hold good. According to Rütimeyer the small "peat-cow" was met with almost exclusively in the oldest settlements, Wangen and Moossedorf. The "peat-swine" of Moossedorf seems to have been little modified by domestication. The sheep is only represented by the small peculiar race. As wild representatives of these species were absent in Swizerland even in the epoch of the pile-villages, they must have been brought from their aboriginal home by the first men who settled on the Swiss lakes. Where is this primitive home to be sought ? An indication is given by the use of stones foreign to Switzerland, such as jade or nephrite from Asia, for the manufacture of axes. The probable origin of the dog is the northern declivity of the great Asiatic mountain mass. The decisive researches of MM. Nathusius and Rütimeyer have placed the Asiatic origin of the "peat-swine" beyond doubt.

Rütimeyer considers that the *Brachyceros* ox has the closest affinity to the Indian forms of the genus *Bos*. The origin of the goat-horned race of sheep has yet to be sought, but it certainly deviates plainly in the formation of the horns from those which may be traced back to the

mouflon of Southern Europe. Even as regards the goat its descent from *Capra ægagrus* cannot be assumed as demonstrated.

The Asiatic origin of the primitive domestic animals of the pile-builders is further testified by the circumstance that both the swine and the dog can be traced, with little modification; as far as the islands of the South Pacific. This does not compel us to believe in a South Asiatic origin of these animals.

The discovery of the "peat-swine" in the old Tschudi-graves of the Ural, and that of the "peat-dog" in the Palæolithic deposits on Lake Ladoga, as well as among the peoples of North Siberia and the Red Men of North-western America, prove rather that these animals were first domesticated to the north of the great highlands of Asia, and that they afterwards spread in company with man, along the northern slopes, on the one hand westwards, and on the other to the east. The way to the Papuan Archipelago might lie, therefore, not directly through India, but through Eastern Siberia and China, and thence southwards through Further India and the islands of the Malay Archipelago. From this point of view a study of the races of domestic animals of Eastern Asia would be of great importance.

In the late Neolithic epoch, as represented by Lattrigen and Lüscherz, we find that the inhabitants, along with the chase of the large ruminants of the forest, were mainly engaged in the breeding of cattle. The wild ox was tamed and crossed with the previously tame race. The transforming agency of breeding extended to other domestic animals. The dog was modified in three directions: there arose a race approximating to the Pomeranian dog, a collie, and a hound. Sheep and goats were developed into larger and more powerful forms. The remains of domestic animals occur here in great abundance. The station Lattrigen alone yielded several cwts. of ox-bones. Hence we draw the twofold inference that this village was inhabited for a long time, and that the people were rich in herds of cattle. Attempts seem to have been made here to introduce new races of animals. The scanty remnants of large races of goats and sheep, which probably drew their origin from the Mediterranean region, show that extended intercourse took place, and that the lake-dwellers had formed relations—direct or indirect—with the people of South-western Europe.

At this epoch, when copper first came into use, and when the implements of stone took a more practical shape, we

find a certain decline in cattle-keeping. In the ox we perceive the beginning of a racial degeneration, whilst the sheep and goat reach their highest development in size and strength.

At Möringen, which represents the Bronze epoch in its fullest bloom, we find a picture totally different from those of earlier days. The remains of beasts of the chase are rare in comparison with those of domestic animals. The bones of the latter are much more broken up, as if with an increasing number of consumers a more minute subdivision of food had become necessary. The domestic races are almost all different from those of the Stone Ages. The sheep has come to the front in place of the former predominance of the ox. The race of sheep is distinctly new, whilst the cows are small and bear marks of degeneration. The pristine dogs have been superseded by the large wolf-hound, and the "peat-swine" is succeeded by the long-eared house-swine. A new domestic animal, the horse, makes its appearance, destined in future to play the most important part in the life of the European nations. It makes a turning-point in the existence of the pile-builders. The water, hitherto the only possible route for intercourse, is to a great extent replaced by the land-road, practically shortened by this swift-footed beast. Cattle-breeding gives place to agriculture, and sheep are therefore kept as better fitted for browsing the stubble fields than oxen.

The same changes occur in other pile-villages. Morges, a rich station on the Lake of Geneva, belonging to the Bronze Age, is the exact counterpart of Möringen. The horse is there met with of the same small, fine-limbed race, and the sheep is represented by the hornless race of Möringen. The same is the case, according to Rütimeyer, at the Bronze stations of Chevroux and Cortaillod, on the Lake of Neufchatel.

The above-mentioned changes in the domestic animals of the lake-dwellers of the Bronze Age can be explained only in part by the transformation of a nation of herdsmen into tillers of the soil. Such a change would scarcely explain the total disappearance of the earlier race and the sudden occurrence of new ones. We might therefore be tempted to accept the view of Troyan and Mortillet, who connect the bloom of the Bronze epoch on the Swiss lakes with the immigration of a new race of men, bringing with them new domestic animals.

II. WHAT IS RELIGION? HYLO-IDEALISM?

By S. Billing.

(Concluded from page 326.)

To resume remarks on the pamphlet immediately in question, "What is Religion?" We have the query, but not the answer. It is much more easy to understand that the world of phenomena originated from intelligent design than that matter so ordinated itself as to produce all phenomenal appearances, including life, consciousness, sensation, and intelligence. We are to condense all phenomena into "thinks": such phrase can only be understandable on the hypothesis that all phenomena are due to intelligent direction, and that phenomena are really thoughts made objective, *i.e.*, the great positive intelligence of the Universe—God, presented his thought in an objective form; in other words, that the thought of the Creator was made objective in substance, and thus the continuous presence or thought of God, presented as phenomena, informs by conscious impression the intelligence of man, and thus man perceives phenomena and conceives (ratiocinates on) the intelligence which formed them: thus, for so much of the absurdity there is found a rational extrication, but then the unaided *monism* must be abandoned. There can be no question but that phenomena have an absolute existence without the thinks or consciousness of man; for it is presumed these exceptionists do not deny the results of physical science. Geology and astronomy teach us that the Universe is an existence, and that our Earth was also an existence even before it could be cognised by an earthly intelligence, for it cannot be assumed that the lowest forms of animation had an intelligence such as could comprehend the relations of thing to thing; hence the world existed, so far as finite *thinks* are concerned, even before these thinks had an existence. If we are to adopt these thinks, the system should explain what and whence are life, consciousness, sensation, and intelligence (the actors and interpreters of things as they be), and should show at the least how they could emerge from *brute* matter (Hume) and dominate it. If the brain *per se* thinks, why was not its action disturbed when Sir Charles Bell stirred the white substance of the brain of a living subject? That the brain is the organ of the mind,

in manner as a conductor, cannot be disputed; but that it is the originator of intelligence, being itself matter, is but an assumption, because a thing can be no more than the product of its particles. We do not say the letters in a book are the intelligence,—they are only the forms of its conduction; so the watercourse is only the conductor of the river. These facts are admitted, because we are cognisant of their whole action. To say that sensation, intelligence, vitality, and consciousness are brain creations arises from the inability of physiologists to find the animating principle. All that interferes with perfect conduction in electrical experiments interferes with the result, and so it is with brain action: cut the nerve of sensation (motor), and the power of movement ceases; vitiate the substance of the brain by disease, we have then an imperfect receiver, and intellectual definition is destroyed. All effects result from causes: galvanise a substance, a frog's leg, and action is apparent, showing that an extraneous something is necessary for movement; and so no doubt it is with conscious intelligence,—an impetus, not of the substance by which it is manifested, is needed to excite its action, and the more free and perfect the apparatus through which it is manifested the greater power there is for its display. If intelligence were but a material consequent, it could not become greater than its source; there would be no such things as religious sentiments, moral aspirations, and abstract conceptions, but if all these principles are indued into matter it then becomes the manifestation of the intelligence of the Creator, enlarging in power as the receptacle becomes equal to its display. "To understand the Cosmos we can only conceive an embodied intelligence as its commencement, its object, and its end," and the "living and visible garment of God" but as the expression of his thought.

In old world thought Theology was all in all, but the methods have changed with the genius of the thinker; but now, "whether he has proceeded from the idea to infinite reality" (Descartes), or "from the contingency of the Universe to its necessary source" (Wolff), or "from the skill and beauty of Nature to its intellectual inventor" (Paley), or "from the moral law to its righteous legislator" (Kant), or "from records of past revelations to the character of the revealer" (Chalmers), (*Dr. Martineau's Ideal Substitutes for God*), we have the true cognition of a God, whether it arises in an idea, or in its formative originator, or in its cosmic realities as presented in design, or moral instigations, or revelations; all tend to the same end.

The treatment of this momentous subject in a purely "historical spirit" leads us directly to the origin and source of man's belief in a power beyond the transitory phenomena which surround him, leading him, by the aspirations of his own religious consciousness, to the yearning and desire for a something beyond and above his sense of finiteness, on which he can rely and trust in firm assurance that the bond can never be broken which connects him with his origin. Earth to Earth, Spirit to God. As "Geology is the methodical knowledge of the Earth's crust, Physiology of living organisms, Psychology of the self-conscious mind, Ethnology of the races of mankind," so "the science of Religion" teaches the rational apprehension of a creating God.

In Theologies we have overladen subtleties which overreach themselves, and are perversions of truth. Every system of Theology presents the miraculous, and the evidences of thaumaturgy are analogous. The great difficulty is that the marvellous always developes into the incredible. The commencement of all creeds is simplicity; the type becomes lowered, and eventually it as a Theology enters into the arena of verbal conflicts.

In the religious sentiment, implanted in the minds of all however it may be stifled or silenced, we have a direct and positive pleader, which, ignoring all superstitions, leads us into the immediate presence of the living Entity, unfathomable to the finite conception, but a living evidence and conscious witness in primitive thought which daringly launches "out on to the ocean of real being." We have "an intellectual and moral region in our natures," "two co-ordinate sources," the former bringing us to a transcendent cause, the latter to a transcendent righteousness; together finding their unity in an Eternal will, and thus "the final object of Reason and the final home of the Conscience are the same."

The monistic theorisers lay great stress on Nature as the all of phenomenal results, ignoring its grand synthesis manifested as a product of intelligence, relegating to matter its office and power. Nature with the Monist is but a manifestation of matter. Are we to suppose that in an universal conflagration (fire mist) chemical agencies were induced, which sifted, separated, and amalgamated the different stuffs recognised as matter, and the other agencies we know as forces: look at it as we may we find but impotence, and, like Lucretius, must seek for a lever to stir the inert mass into living substances.

What is Nature? Is it to be limited to the ordination of

the material phenomena with all its vital energies, or is it to be extended to the Universe with all its cosmic realities,—with its galaxies of suns, and probably their attendant worlds,—all so accordant in action that the combination is unity? If this be so, plus intelligence, ratiocination, and wisdom, then Nature is that which the religious mind recognises as God—the ordinator, creator, and maintainer of matter, its formator, and law-giver. Contemplate the subject as we may we are compelled to admit an originator, or accept the most astounding of miracles, chance, with its billions of millions of accidents, resulting in homogeneity. Does it follow that Monistic nature has uniform action throughout the stellar universe? Although the same materials, as manifested by spectrum analysis, appear to be the components of all: even granting that the inorganic substances are the same, still their chemical amalgamations may be wholly different, as we see even in earth mixtures,—*e.g.*, isomeric compounds,—the same substances in different amalgamations producing opposite results, delicious odour or rank disgusting substance, refreshing beverage or deadly poison. It is more than probable that other orbs than Earth are inhabited, and present a flora and fauna, and probably present different constitutions to those we know: there may be also climatic differences which would increase the diversity, for position and magnitude must be taken into account. If this be so, it follows that Nature is discriminating, *i.e.*, intelligent, and adapts her powers to the uses to be applied. Is it to be said that all this can result from chance? If, then, chance be excluded from the problem, in what then does Nature differ from that grand reality of power, omniscience, and omnipresence we term God? In Nature we have direction, creation, and maintenance; the adaptation of mechanics and chemistry to direct differing conditions of substances, all intelligibly marshalled. There is no law of chance which by any possibility can arrive at the same conclusions: add direction to chance, and the chaotic idea, chance, must be abandoned.

In Natural Science the true man of Science appreciates the display of natural harmony—the unity, the multifold variety, and the delicate balance of "physical and vital activities." The greater his knowledge the more fully his mind embraces the complex inter-relations of the animal and vegetable world. The hills, the plains, and the waters tell the history of the world when there was no sentient inhabitant to record it. In their harmonious relations it may well be said that there is not only beauty, but

goodness, conducing to an end to be achieved in far on and outreaching æons of time. In the bowels of the earth, in geological eras long past, were stored those deposits which have been and are the great engines of civilisation,—stored in times of seeming desolation, blazing volcanoes, devastating storms, and their sweeping floods. Was the order which resulted from these seemingly devastating ruins accident? Were the ores buried in the earth accidents anticipating the advent of man and his necessities? Shall we not rather say that herein is the evidence of a design so far reaching as to order the why and the when, guiding and maintaining all in the forms of rigid law, unerring in results, provident in its exigency, anticipating the necessities of denizens of Earth not then in being? A better name can be found for this providence than Monism and its shallow deductions affords. Where is the mind which can measure the grand scheme of the Universe? Where the mind which shall define the limits of this providence? The further we probe Nature's characteristics, the further we can fathom the science and methods of Nature, the further we recede from accidents as a cause, and find in our researches the acts of a great and inscrutable will, which fashioned events and anticipated all the necessities which must evolve when the principle of intelligent life was established on Earth. Nature is the great mother; she dips into matter, and completes its subjugation by compelling it so to act as to satisfy her demands: this is shown in the aptness of phenomenal display, where every want is supplied, every gap profusely filled, yet without wasteful expenditure; there is nutriment for the creature and seed for the reproduction of the vegetable protoplasm, the support of animal life. Thus we find systems within systems, each to each linked by a bond of order wherein there is neither laxity nor loss: all are absorbed in the endless routine of existence, each playing its allotted part, all leading up to and ending in its complement —MAN.

C. N. appears to confound Religion with systems of Theologies or creeds. In all he suggests there is no presentment of humanitarian realities which tend to elevate the race; but this is impossible with a philosophy which commences in self and consolidates all in self, even creation —*i.e.*, in the Ego.

We find a long dissertation on the wantings apparent in theologies; Catholicity appears to be the *bête noir*. Gibbon has done this work better than C. N. can ever hope to do: a citation of the celebrated XVI. and XVII. chapters, in

the second volume of his history, had there been a necessity to touch the subject in any way, would have been all-sufficient. The wantings of Theologies, even with a citation of all their horrors, can add no glory to Hylo-Idealism. Then follows a dissertation upon Mr. Bradlaugh; what has it to do with the question, except perhaps to show the animus of the writer? Mr. Bradlaugh asserted his opinion, and accepted his position. He had accorded to him perfect freedom of discussion. Of what has he to complain? that general opinion is adverse to the propositions he promulgates. The wonder is that he, so able a man, has arrived at so illogical a conclusion (*vide* Maurice Davies's "Heterodox London," p. 116 *et infra*). So also we are told that the principles of Catholicism can claim no superiority over those "which inspired the French Revolution," whatever its result. The sense of wrong aroused the people, and they triumphed; law and order were perverted, the conception of a God banished, and greed, rapine, and murder reigned supreme. This is the result of the *Ego* and Hylo-Idealistic thinks; a despotism linked with irreligion blotted out all good, and ended in the establishment of a military despotism which was restrained by no act deemed needful for the consolidation of its power, and was subversive of the rights and freedom of all who came in contact with it. What has this to do with Religion? which, in its true sense, exemplifies the humanitarian principle "Do as you would be done by." Then follows an exposition of Pantheism; the grand idealisations of the Greek mind are sneered at; "sun and rain are translated by imagination into smiles and tears. The author would have been wise, before he gave vent to his imaginings, to have consulted Max Müller, Cox, and the first two vols. of Grote's "History of Greece": he then would have had some conception of the hold religious aspirations—Pantheistic if he pleases—had on the commonalty of the nations of Greece. Their idealisations, making gods and demons care-takers, were emblematic, and became the conscious cognition of the providence of the Supreme God. It would also have been wise to have consulted the works of Max Müller and Monier Williams before giving a pronounced opinion of the Vedas and other sacred works on the primitive worshippers of India. It is easy to conceive that a man who concentrates *his religious* (?) ideas in the Ego could never rise to the sublime conceptions of primitive worshippers. Every enquiry rightly directed as to religious belief finds the germ and intent of the founder, be the creed what it may, moral, pure, or humanitarian. It does

not follow that when it is perverted into a Theology that therefore its origin was impure. We are then indulged with observations on Pantheism; and what is Pantheism but the worship of the spirit which was supposed to underlie Nature? It was not the worship of matter, or man, or the self! Thackeray says when we have well studied the world "how supremely great the meanest thing in this world is, and how infinitely mean the greatest;" and he is mistaken if there is not made "a strange and proper jumble of the sublime and the ridiculous, the lofty and the low," and in the end "know not which is which." How forcibly this applies to the absurdities of this Hylo-Idealism theorem is illustrated in a note (p. 19), by its wonderful logical discoverer, who centred all creation in his own finite self. He tells us, "All this mysticism, this ascription to an objective deity of our own subjective feelings, seems quite elucidated by the principles of Hylo-Idealism. Mind in Nature there is, but it is our own mind, alike the concipient and precipient of Nature." Thus, to get rid of any reverential or moral attribute, we are to adopt a mysticism only worse confounded, and are to end in not knowing which is which.

Modern science, as any logical or sensible man would construe it, is very far from teaching that "man is the measure of all things." It shows the insignificance of the human mind in comparison with the energies of Nature. Man discovers effects resulting from causes, and mechanically imitates Nature to produce results which may be beneficial, primarily to the satisfaction of individual greed rather than, to the promotion of human happiness: to this latter result absurd philosophising and socialistic reasonings stand in the way of its consummation. In vain we are to look for an amelioration of our social status if "man is the measure of all things," or "of the universe for man." The animal man is self, and self only; and well may the Hylo-Idealists deny the purer and better aspirations of man. Self is greed, and we have its aspirations in every social position, and unhappily it grapples too successfully with the aspiration for freedom from the animal nature of man to which Materialism would chain it. If soul, intelligence, consciousness, vital energy, and sensation are the emanations of matter, man cannot rise higher than his origin, and, were it so, would for ever remain but a conscious beast; for what creature is so cruel as the animal man? All which makes life really good, beautiful, and desirable, the humanitarian principle which alone can elevate man, is intellectual truth, eliciting moral realities ending in abstractions which practically

illustrated make it possible for man to live with his fellow.

C. N. and his followers should consult German scholasticism if they wished for a classical disquisition on the theory of the Sophist. It were a better inspiration than Dr. Büchner and their own Messiah. When he says that Erigena, Averroes, and Bruno found in Pantheism "their spiritual home," he shows he has never read their works,—if he has, then he has not understood the theses they propounded.* With such authors, and too frequently with their readers, a parade of grand names is all-sufficient; it is no matter whether wrongly quoted or ignorantly introduced, they go to make up the claptrap; but perhaps C. N. may stand excused when a man known to fame endeavoured to make Bruno and Gassendi—one of the finest intellects of his time—the stalking-horses for his own Materialism. Carlyle and Goethe were not spared, and the great science of Maxwell introduced with a sneer; and the *ethic glow* was a mechanical monstrosity which existed only in his own conception.

It is quite true "*If* our simple sensuous perceptions are the result of cerebral organisation, it is evident the same must be affirmed of the ideas produced from their syntheses." Well may we have an "if": it is evident C. N. was not convinced, despite the positive affirmation of the notes. He then kindly tells us—"Though incapable of universal scepticism, and forced to assume the real existence of some protoplasmic substance generating all those images of which our consciousness is composed, we shall not clothe this protoplasm with Divine attributes, and bow in worship of the absolute and unknowable." He says that the Agnostics are but half-hearted; but this may be said, that whatever may be their conclusions the leaders of the movement are generally men of high science, and do not glean digests in order to establish their problem. The Agnostic holds that the existence of anything beyond and behind material phenomena is unknown and (so far as can be judged) unknowable, and especially that a first cause and an unseen world are subjects of which we know nothing; thus contravening the scientific parallel that the unknown shall be interpreted by the known. The phrase Agnostic is said to

* If C. N. desires to know what was the teaching of Erigena (with his ideas Bruno greatly concurred), he will find a Synopsis of Erigena's work "De Divisione Naturæ" in the fourth volume of Sharon Turner's "Middle Ages" (p. 417 *et infra*); he will find something more than Pantheism there. Erigena's work on the Vision of God has eluded modern research. Nor in the account of Averroes and Bruno will he find any status for his assertion (*vide* Draper's "Conflict of Science and Religion").

have been suggested by Prof. Huxley, who is twitted with the endeavour to make men know how little they know. The Bishop of Manchester says "The Agnostic neither denied nor affirmed God; he simply puts him on one side." It is a higher grade of mind to refuse to discuss that deemed unfathomable because it cannot be reached by the scientific method, than to deny *in toto* the existence of a creating God and substitute in his place the thinks of individuals whose only possibilities of information are sense impressions. The presentment of a tree, a flower, or a creature to one of these great thinkers should shame such a proposition into an utter confusion. Thinks, what thinks!! the impression of the surfaces of images on the senses. Well it may be held that the animal instinctives and man's mind are the same in calibre and substance, for so far do some of our *savants* carry their theses, presenting, as some do, the very commonest and necessary and unmistakable animal habit as the proof of a discriminating mind! Both animals and men have their tribal distinctives, differing in both with the species, but man has, in addition to animal instinctives, "the power of forming abstract ideas, such as humanity, truth, &c.; a power of apprehending not only existing objects, but also the fact of their existence; a power of reflecting on their own being and consciousness; a power (by voluntary attention) of recalling, or seeking to recall to mind our past thoughts; a power of uniting two simple intellectual apprehensions into an explicit affirmation or negation,—that is, power of judgment; a power of induction; a power of true inference, of intellectual emotions; a power of expressing intellectual feelings and ideas by definite external signs, intellectual language, and a true power of will."

We are also told that if we were consistent we should renew the old doctrine not only of an animal, but also of a vegetal soul. This subject was discussed at the meeting of the German Association at Munich (1877), and was asserted by Nägeli and Haeckel, and repudiated by Virchow. Nägeli no doubt founded his argument on the Aristotelian idea, which was utterly distinct from the theological meaning of the word soul. The Ancients considered the soul as the unifying power which makes vital activities a synthesis, or the bond which makes the varied activities and weaknesses an united power. As an illustration may be cited the old man and the bundle of sticks, the cord which binds them making their synthesis,—a faggot,—weak individually, strong as a whole; and thus the *animus mundi* was a grand idea—multiety in unity.

We are also told—" If, then, in our definition of matter we substitute energy for extension, we shall no longer be able to distinguish between matter and spirit, and shall be forced to find in Hylo-Idealism the reconciliation of poetry, philosophy, and science." Is this, then, the all which makes the sum of life, and for which thinking men should aspire? Is there no room in this theory for duty, moral aptitudes, and religious sentiments? " No reasoning can be true which ends in an absurdity."

The great object and end of life should be the fulfilment of duty, however multifarious may be its action; in duty are all humanitarian sensibilities, all morals, and religion. " The more thoroughly a man is impressed by the idea of duty, the more his whole being is saturated with the idea, the more goodness will show itself in all his, even spontaneous, actions, which will have additional merit from their very spontaneity." It is the selfdom and self-interest combined; the first teaches the satisfaction of the needs due to the self; the latter that grand humanitarian principle which is the bond of all social accord, and sets forth the true relations which each man has to his fellow, and ends in the revelation of the grander principle which at the same moment knits man with man, and man in his strife for perfection with the supreme ordinating principle: then man is uplifted from the dominion of self, and in the concentration of his energies, to the contemplation of the origin of all things: this is Religion,—disclosing the link which binds the human in the divine, enlightening his search for purity and truth, wherein is alone to be found that bond link which makes the Universe akin, and the human and the divine an inseparable unity, harmonious, effective, real.

Little does C. N. appear to know of the religious feelings of such men as Wesley, Wilberforce, and thousands of other eminent Christians, and we may be well content that he does not give a disquisition on Religion. He sets out by asking, What is Religion? but most carefully eschews any relation of the realities and duties it enjoins on those who truthfully believe in the faiths they profess. He says, "Even by orthodox Christians the value of Religion is made to consist in its supposed ethical necessity rather than in any intrinsic and transcendental worth. It is justified as an indispensable means of human welfare, not glorified as the supreme end of human endeavour, with the implied inference that should it cease to be useful it will at the same time cease to be desirable." In other words, mere Utilitarianism. The records of history convey a different decision. There

then can be no wonder, when such views as above are enumerated, that the author does not tell us what is Religion, unless he supposes the solution of his query is Hylo-Idealism. He is careful to tell us he is not an Atheist; but in what Hylo-Idealism differs from Atheism I am at a loss to conceive: his ally, Constance Arden, affirms it to be pure Monism. He says, "Nor does it seem more glorious to be a little lower than the angels than to be the creator and fashioner of an ideal host of heaven, though their bright array be the offspring of a material organ."

"Having traced our intellectual and moral faculties to their seat in the brain, we shall cease to enquire for the noumenon of this ultimate phenomenon, and shall find ample scope for ideal aspirations in the sublime generalisation, that the sun, the moon, the stars, the hills, and the plains are but products of our finitely infinite personality. Man, if pure of heart and lofty of mind, must be crowned with glory and honour, whatever be the first cause of his sovereignty; a material origin cannot degrade his thoughts, if lofty." Can bathos go beyond this? The sun and all the astronomical phalanx, the angels and the hosts of heaven, all the creations of Man!! The Messiah steps in with a note, to cap this grand sublimity. "This apparent *catachresis*"—a grand word—"will be seen to be rigidly scientific when we recognise the sublime facts that life and death are only changes of condition, not of essence,—that the glories of our birth and state are shadows, and not substantial things."

It is quite possible that the theory of Evolution, as pourtrayed by Mr. Darwin, may show that there is no gulf between animal and man so far as his animal origin is concerned, and so it may show that there is a gradation from the lowest forms of life in mental (so to speak) processes; but it also shows that these gradations only ensue when the receptacle (not always a brain) is fitted for enlarged action; but it is quite another thing to say that the mental attribute (be what it may or however displayed) has its origination in the receptacle,—in other words, the vehicle through which it acts. We find conductors adapted to sustain greater strains, but not those of creation,—*i.e.*, the organ is exactly adapted to the use to which it is to be put. There are some more pages of surface science, and surface reasonings and absurdities, in support of this theory exploded more than two thousand years ago; in fact, condemned and refuted almost on its utterance. It is most difficult in this the nineteenth century to treat the matter with patience, or to

believe that men can soberly stand forth and advance this doctrine, denying as it does the pure Materialism on which it is founded, and the pure Idealism, another branch of its subjects, yet attempting to combine the two, producing a monster which is even in its very enunciation a shock to practical common sense. As to the metaphysical argument advanced, viz., that the Ego has no cognisance of the non-Ego, it being only an image. When a man, an Ego, sees another man, a non-Ego, do in similar circumstances exactly what the Ego does, it seems reasonable to conceive that the non-Ego is rather more than an image or a think, the more especially if the non-Ego, as a requital for an insult, should obliterate an organ of sense, say the eye. It is doubtful whether the Ego, on so practical a demonstration of reality, would continne to think that the non-Ego was only an image, or a think, or the result of its own cogitation,—or whether the excitation of sensation resulting from this practical analysis of the think would result in the belief that all the suffering inflicted was a mere synthesis of circumstances resulting from the think. The whole thing is too absurd to reason on. A ploughboy would confute the whole thesis by a rough and practical solution. In conclusion there are several pages couched in the peculiar style of these thinkers (?); but what can be expected when a man attempts to defend an absurdity which if accepted would displace all the guards with which humanity is fenced, but which is pretended to be an exposition of the grand good,—the reality of life, the object of man's place on earth. We meet such a phrase "since the" triumph of Christianity. What has the system to do with Christianity? Is it canting, or ignorance of the meaning which the word Christianity should convey?

Mark the summing up. How grand! What a boon to humanity, what a kindness to the non-Ego, that there should be a cognition of being! "In an age when some ideal of moral beauty inspires all the noblest and most beneficent natures, rigorous analysis is for the time undesirable. It would desecrate those elements of truth which are always interwoven with every vital and beautiful form of Error, and by a premature disenchantment and disintegration would destroy the old principle before the new one is ready to take its place. By dissecting away what was still throbbing with life, it would cripple where it was meant to heal, and would pull the skin from the snake instead of waiting until it became a slough. But in our days, when art, morality, thought, politics, and education are finally separated from

religion: when the living soul of ancient theosophies has departed; when the stern beauty of divine philosophy has well nigh ceased to attract even youthful votaries, our only hope of salvation lies in the conscientious endeavour to draw new life from Nature, and make Science itself a well-spring of ideal truth." With the result that it would all again be the old cry of the leech, give, give!

In this Hylo-Idealistic theory we have much metaphysical absurdity, Ego's and non-Ego's implying man only cognises himself, all else being mere images. If they be images only one may well be surprised at their tenacity; they have existed since time was, before man's advent on Earth, and probably will exist until the end of Time.

To grapple the problem in a philosophical spirit we should say that consciousness grasps the outer world, and reason and memory connect it with the interior, and thus the external and objective world becomes part of the self, or Ego, and it cognises the non-Ego as a part of the phenomenal world; and by the process of ratiocination the Ego, the non-Ego, and all other phenomenal presentments, find their unity in consciousness, and thus constitute for each the world of fact and being. All facts are the verifications of their repetition, vouched for by the senses: this is experimental evidence.

"The facts of memory imply that each of us has the power of knowing with certainty past real existences, and he who trusts his memory affirms this." The memory recalls its experiences, and through reason has relations with things which had existence before the thinker, and all others of his generation, had being, and will exist when he and they have ceased to be denizens of this Earth; *e.g.*, Cuvier at Montmatre found the skeleton of a small creature the skull of which had its lower jaw bent in: trusting to his memory of the past and his scientific experience, he predicated that when the stone was chiselled from the lower part of the pelvis there would be found a pair of marsupial bones,—and so it was: thus his memory and science made him akin to a fauna which had being aæons and aæons of time long past away, showing that in the world of facts we have to do with something more than evanescent images, *viz.*, substantial and real substances. Cuvier did not create the marsupial animal; he only discovered it. This Hylo-Idealism is a construction of the imagination and false logic. Even Lewes cannot help them when he tells us "that which is unpicturable may be conceivable, and the abstraction which is impossible to imagination is easy to

conception" ("Problems, Life and Mind," i., 420). A man "cannot imagine his own annihilation," but he "can conceive it."

The Cuvier illustration shows us that "our senses are recognised as telling us of an external world really existing in utter independence of us, and scientific views and theories are constructed and accepted in harmony with this recognition." Idealism cannot be true, because "it contradicts that conception of the Universe which the advance of Science makes more and more convincing and secure," and, moreover, "it asserts that we have not that direct knowledge of the world about us which our own minds assure us that we certainly have." Thus, "by building on the direct declarations of consciousness as a foundation, we may be certain that we really know an external world, and many qualities of independently existing things, and not merely our own feelings, or a mere amalgam made up from ourselves and from external bodies"; thus, "that an external world really exists independently of us," and that its "parts really possess those very powers and properties which our senses and our reason combine to assure us."

"Self-conscious, reflective thought is our ultimate and absolute criterion," for thereby alone "we know we have feelings." Without thought we might feel, but we could not know that we felt or know ourselves in feeling. "We believe in the certainty we obtain through the senses, though the certainty itself is not in them. Our ultimate appeal and supreme criterion is the intellect, and not sense, and that act of intellectual perception which is thus ultimate we may call intellectual intuition."

The standpoint of Hylo-Idealism is that "man is the measure of the Universe." Capt. McTaggart has made a correction, and adds for man, which correction is accepted. This does not change the monstrosity of the theorem presented as the highest possible aspiration of man, with its brain creations of mind, thinks, false images, metaphysical Egos, &c.,—the isolation of man in the self,—and that these thinks, creative powers, Materialism, is to be pursued to a certain point, so also Idealism, but neither to its logical conclusions. Haeckel's Monism differs from this Hylo, as does Berkeley's theory from its Idealism. Haeckel admits a cause, Berkeley a God: perhaps the protoplastic presentment is Haeckel's cause, and the thinks Berkeley's God!!

Herbert Spencer says, "If Ideation be true, Evolution is a dream; not Evolution only, but the whole of Physical

Science." Thus we find the great masters are opposed to this Hylo-Ideal theory in one or other of its forms. There being a harmonious relation in phenomena, there must be the same harmony in ideation, and ideas by the transformation of intelligence become reason and wisdom. The phenomenal, which is an effect, is transfused into its cause; the truth becomes known as part and parcel of ourselves; the beyond is then reached where intelligence is transfused into spirit, which, existing in its own truth, is freed from the trammels of the material phenomena, and exists with cognate existences in a world of intelligence where dwells the supreme cause of all boundless and eternal.

So far this weary work is accomplished, and we are presented with the Hylo-Idealistic theory as propounded by C. N. Captain McTaggart's work it is unnecessary to enter upon. Both assume the same basis, but this latter work is methodical and logical, so far as the subject will admit of reasoning. The subject is so fantastical that the wonder is it should find so able a defender. Take any basis as a starting-point, and metaphysical subtleties will found thereon an argument. Both works contain appendices: C. N. has six, the Captain five. That by Constance Arden is certainly an able review, or rather *resumé*, of Prof. Huxley's article ("Science Culture and other Essays.") So far as Automatism is concerned, with which she seems to agree, it is merely necessary to cite H. G. Lewes's summation:—"We can conceive an automaton dog that would bark at the presence of a beggar, but not an automaton dog that would bark one day at a beggar and the next day wag his tail, remembering the food the beggar had bestowed." Further, Lewes denies that Descartes favoured animal automacy. He says that Descartes was merely contrasting mechanical movements with animal motion ("Physical Bases of Mind").

As to the brain theory of mind paraded through the work, can it account for the following well-authenticated facts? A lady, the owner of a yacht, took a trip to Rome, taking with her as maid a Devonshire cottage girl. When at Rome the girl fell ill with fever, and was removed from the hotel to the yacht. Fear prevented the hiring of another attendant, and the lady attended the girl until she died: no napkin was at hand, and she covered the face of the corpse with her own handkerchief. On arriving in England (no possible communication having been had with the girl's connexions) the lady determined to carry the sad tidings

herself. On arriving at the cottage she found the mother seated at the door, and before the lady could speak said "I know what you have come for." She then detailed the circumstances of her daughter's death, and the covering the face with the lady's handkerchief. So also the incident mentioned by Col. Meadows Tayler in the story of my life —that of the Dead Soldier and its Incidents.

III. THE SAND MARTIN, AND ITS MIGRATIONS.

By Rev. Samuel Barber.

ABOUT five miles south of Liverpool the suburb of Grassendale skirts the Mersey, where the river is about 2 miles wide. There is a sea-wall, or rather a wall-fronted esplanade, drained by passages underneath the parapet, and these open out upon the wall by apertures measuring about 10 inches by 6. Within these drains, and actually under the feet of the promenaders, a colony of sand martins have, for many years, found their summer home. At high water these birds may be seen skimming over the surface of the river, and beating along the coast, in search of insects, in a very methodical manner. Their chief hunting-field appears to be in front of the wall, which contains their eggs or young. No amount of wind—and there is plenty of it in this part of the world—seems to deter them from the chase. A casual observer might wonder where the insects came from to support such continual hawking, for the most ingenious devices would scarcely enable him to secure six flies in as many hours, if indeed he could find any at all that the breeze had not carried away.

Nature, however, abhors stereotyped methods in the regulation of animal economy, and exhibits in the varied conditions of bird-life, and in the adjustment of the appliances by which it is sustained, an elasticity and fertility of resource no less admirable than the variety of her forms. This is particularly true in the manner by which the supply of food for each species is furnished, and the balance of animal life maintained.

The sand martin, more than the swallow, observes regularity in the time of its appearance in this country. In fact

it seems to come *to the day*, or at any rate two or three days will fairly embrace their variation from the appointed time. Observations extending over many years induce us to expect them here on the 15th or 16th of April.* No doubt the condition of the weather has *some* effect upon this regularity of appearance, but very much less than it might reasonably be expected to have; and it will, I think, be found that the effect of weather upon the arrival of our British Hirundines has a relation rather to their *numbers* than to the mere fact of their appearance at a certain date. In the case of the other species—the house swallow, martin, &c.—there will generally be found a considerable instalment about the usual time given in the Natural-History Calendars; but if the season should be cold and stormy (as indeed it often is) the numbers of the first arrival will be reduced to a minimum. It may be remarked, however, that occasionally, in bad weather, the numbers seem to go on increasing for some time after the first arrivals are noted.

The migration of birds has been often and justly cited as affording the most striking and wonderful evidence of the operation of Divine Wisdom in allotting to the creatures, for a special end, an insight far transcending their ordinary intelligence. And in the modification of that instinct, and its subservience *to actual circumstance*, as in the case we are now considering, there is a striking manifestation of the power of Him who governeth all things in heaven and earth. A too close consideration of the *unity* of Nature, and of the *ordinary* working of the Almighty Artificer, may tend, with some minds, to darken through familiarity the truth that "Nature's law" presupposes a Law-giver: it is well, then, to consider also attentively the *exceptions* and *variations* from her ordinary course, inasmuch as the character and end of a law is often revealed to us by its interruptions.

It has been thought by some naturalists that swallows send forth scouts in advance of the main body, to examine, at the time of their migration, the climate of the country that they purpose visiting. And when we consider the distance of the countries to which they migrate, and the very great difference of climate existing between their summer and winter habitations, this appears not an unwarrantable supposition. It is, indeed, hard to imagine any other way of accounting for the delay of their main body when the weather is exceptionally severe in spring. And this is, to me, a much more reasonable way of accounting for the

* An article in the "Globe" lately placed the arrival of swallows about a week or ten days later. But my date, as given above, has been verified.—S.B.

fact of an occasional delay (which will scarcely be disputed) than by supposing them to possess, while in Greece or Asia Minor,* a kind of prophetic intuition or second sight as to the character of the *weather in England*. Or we may explain the matter in this way: the most vigorous birds will be likely to start first, and, if disappointed in the matter of weather and supply of food, would return to a warmer climate. It would not be extravagant to suppose that their return would then be a warning to the rest; indeed we have reason to conclude that these birds possess the power of interchanging ideas, or at least communicating impressions.

It may be thought an anomalous circumstance, by those who delight to study the *regularity* of natural laws, that many species of birds should so readily deviate from their peculiar habit, or instinct, in the construction of their nests. In the case of the sand martin the burrow by which the nest is approached is often 5 or 6 feet long, so that a vast amount of labour, in boring, is saved by their utilising an artificial cavity. And thus it happens that in the animal world, as well as among men, special intelligence overrules ordinary law, and the general good of the race is provided for, rather than the exact and unvarying execution of a *plan*, in all its details. From this point of view the dignity of animal life is enhanced, and we perceive in the whole scheme of Nature the expression of Infinite Benevolence, continually operative, and adapting circumstances to the wisest purposes.

IV. ON ELECTRICITY AND ITS PRESENT APPLICATIONS.†

By W. Fraser, A.M., M.R.C.S. Eng.

(Continued from page 337.)

AS none of the necessary elements of life are so indispensable as Electron, so there are none of them so universally diffused, accessible, and in fact inseparable from all living things. These can be very easily, and often with fatal results are, deprived of heat, light, air, or

* It seems ascertained that Hirundines migrate to this distance, at least.
† Read at the Aberdeen Philosophical Society, February 5th, 1884.

water, and food; but no prison or solid walls, no laws or ingenuity of man, can deprive them of the presence and ministrations of this all-pervading spirit. The toad or frog shut up for hundreds of years in a solid rock can be kept alive by this, the only *pabulum vitæ* which can have access to it.

The invaluable services of Electron, too, for specific purposes are also at the constant command and use of all mankind. The breast of mother Earth can be tapped, so to speak, anywhere and at any time, and the necessary supply of energy drawn from it, provided the individual has the requisite knowledge and skill to use the appropriate means for the purpose. These means, in the present state of our knowledge, are, it must be admitted, somewhat complicated and expensive, and sometimes not even devoid of danger; but in the progressive advancement of Science and experience there is no doubt the means will yet be discovered by which his services, whenever and wherever they are wanted, will ultimately be much more readily and simply brought within the reach of mankind.

When Electron is made closely to embrace and to pass repeatedly round a portion of his favourite metal, it becomes magnetic,—that is to say, so imbued with his spirit as to have the power of attracting to itself, and holding firmly, portions of the same metal equal or even greater in weight than itself. This fact or phenomenon forms the basis of what may be called the science of Electro-magnetism, and is the source of the motive (electromotive) power which is the great agent in many of the achievements of Electron. A variety, too, of the metal iron, called Loadstone, is to be found in some parts of the world which has the same quality, with the addition of being able, by close contact and repeated embraces, to communicate it permanently to other members of the ferric family. And in connection with these an important passage in the history of Electron has now to be mentioned.

These magnets, as they are called, have a tendency to arrange themselves, and when allowed perfect freedom of motion *do* arrange themselves, in a line parallel, or nearly parallel, to the axis of the Earth,—a wonderful property, which is taken advantage of (and has been for many centuries) in the form of the mariner's compass, for the safe guidance of ships across the pathless ocean. But less than one century ago a Danish *savant*, named Oersted, discovered another singular peculiarity of these magnetic imps, namely, that the instant they find themselves in the presence of

Electron they make a reverential sign of obeisance to him, which he (doubtless in some way to us invisible) acknowledges). If he approach them in front, they turn to him by a movement to the right; if he approach them from behind, they face round to him by the left; always retaining their position across, or at right angles to, his path, during the presence of their great chief.

Little did Oersted foresee the important uses afterwards to be made of the little odd peculiarity he had discovered; but succeeding wise men who have given themselves to the service of Electron, by taking advantage of this devoted attachment to their chief of these small magnets, have devised a way by which persons living at the greatest distance from each other may hold almost immediate correspondence. And this is the way in which this Godlike achievement can be accomplished:—A copper or iron wire is laid either above or below the ground, or along the bottom of the sea, of any length, from a few yards to thousands of miles, and the Genie being exorcised, *secundem artem*, from his place of concealment, can be sent by qualified attendants or operators, along this favourite pathway, to the place intended, where he is made to pass across one or more of the magnetic imps, who instantly give him the *quasi* military salute just described. These transmissions and salaams can be repeated so rapidly, and timed and grouped together in such a way, that a code of signals can be formed by them that shall be equivalent to ordinary language, and be easily transferred into it by those in charge at either end of the wire of communication; and so rapidly can he do his work that three or four clerks, at either end, can be sending and receiving messages, and nearly as quickly as they could be spoken. At the same time, by the same wire, Electron can even write out the intelligence he conveys as fast as it is sent, provided he is supplied with the necessary materials and suitable apparatus for the purpose.

But what is still more wonderful, and demonstrative of the power and wisdom of the Master whom he serves, this Genie can in an instant send his voice, in an audible and intelligible form, to a distance of hundreds, or even thousands, of miles. And this is the way in which this lately discovered power of his can be applied to the service of mankind:—An imp belonging to the ferric, or some of the other tribes for which Electron has a partiality, is selected,—of a thin, expanded, delicate, and highly sensitive structure, and is placed in a position where the Genie can have free access and contact with it. A person wishing to speak with another

at a distance (whether a few streets or a thousand miles away) has only to address his words near to this imp, whose sensitive body is immmediately made to vibrate in harmony with the sound-waves of the voice. These delicate and invisible vibrations are recognised and received by the Genie where he lies enveloping the atoms of the imp, and are by him carried to the other end of the line of transit, where they are repeated by him in the body of another imp similarly placed in regard to the conducting medium, with the result of causing corresponding vibrations in the air, so as to reproduce sounds and words exactly corresponding to those emitted by the speaker at the distant station, so that his listening friend can hear them instantly and exactly as they were pronounced,—so exactly indeed (as probably many of you have had an opportunity of verifying) that the person listening can say at once " This is Mr. So-and-so," or that is an Englishman, an Irishman, a Frenchman, or a lady, or a child.

Intelligence so transmitted, by either of these methods, can be quickly communicated by messenger to the person for whom it is intended, or to the public by means of the newspaper and the post; and so the spirit Electron may be said to supply the office of a nervous system to the world, keeping all its parts in immediate sympathy with each other, and enabling them to act in harmony for the general advantage. And thus, by the immediate and unimpeded interchange of intelligence, and the prompt removal of prejudices and misunderstandings throughout the world, Electron is becoming one of the chief harbingers of the "good time coming,"—that millennium which many of the nations are longing for and looking forward to.

The delicate perceptions and touch of women are found to be peculiarly adapted for these manipulations, and it must be gratifying to the advocates of women's rights to find that a new field has thus been opened up for their employment which is at once congenial, scientific, and remunerative. In one room alone at the London Post-Office, in St. Martin's-le-Grand, there are a thousand female clerks, whose active brains and fingers are constantly at work; and from this instance we may judge of the vast army of women employed in the service of Electron throughout the world!

The movements of a Spirit such as Electron are essentially of a different nature from those of material things which are acted upon by the laws of gravitation and other forces which are readily recognised by our senses, and which can be intelligibly comprehended, measured, and practically

formulated. Spirits like Electron, being almost destitute of weight, cannot, unless in a slight and indirect way, be influenced by gravitation. Their inconceivably rapid motion is entirely unlike that of gravitation, being more of the nature of mental emotion or of vibration than of a bodily change of place. The Electric Spirit, in so far as it enters into the constitution of material things, and functionally permeates and envelopes them, will accompany the world in all its movements; but in other respects it will not accompany it, and will only but slightly participate either in its rotation or its orbital motion.

It will thus be understood that the Earth, in its diurnal motion, brushes through and athwart the portion of this spirit that lies nearest to it at the rate of 17 miles per minute at the Equator, and at a gradually diminishing rate towards the Poles; or, it comes to the same thing to say that the Genie traverses the surface of the Earth at this rate along the parallels of latitude from West to East. One result of this is that the whole army of magnetic imps throughout the world that have, from their size and constitution, the requisite freedom of movement, must continually assume the rectangular or military position towards their great chief; in other words, they will point in the direction of the terrestrial Poles,—a permanent and invaluable phenomenon, which, utilised in the guise of the mariner's compass, constitutes one of the greatest blessings to mankind. As a curious presumptive corroboration of this idea, a well-known experiment may be called to remembrance. If a rod of soft iron be suspended at right angles to the electric or magnetic current,—that is to say, nearly north and south,—with a considerable dip to the north, and smartly and repeatedly struck, so as to put its particles in a state of vibration, these particles, or a certain portion of them, will assume the deferential or military attitude, and retain it *permanently*, along with the magnetic power which it confers, thus converting the rod into a magnet.

This powerful Genie does not disdain to act the part of a most useful and obedient servant or slave to mankind. Without his spontaneous assistance, as the fermentative agent, the processes of baking and brewing could not be successfully carried on. In the nutrition and growth of plants he acts a very important part, and, as the late Sir Charles Siemens has experimentally proved, can be used artificially to expedite and improve their fruit-producing powers to an extraordinary extent. He can, by a little skilful management, be made to work sewing and other

domestic machines; to ring bells of warning at any distance that may be required; to transmit messages to any distance with accuracy, and with a promptitude that no human messenger could equal; to act the part of a watchman, and give instant warning of the approach of burglars or thieves. He can send warning to a distance of the escape, and anticipate the movements, of criminals, so as to lead to their apprehension, and thus prove a powerful aid to law and good government. He will even detect the outbreak of fire, ane give timely warning of it. He transmits true time, and keeps our clocks in harmony with each other in all parts of the kingdom. He gilds and plates our spoons and metallic goods; he reproduces to any extent our medals and works of art, including the most valuable engraving plates. He can, at a safe distance, detonate the charges used in quarrying and mining, and can explode torpedoes and other explosive contrivances, whether used for warlike or peaceful purposes.

Dr. Bain suggests that he should be employed by schoolmasters for inflicting the various degrees of punishment required in public schools; and it has been proposed that he might with advantage be made to perform the office of public executioner, and by an instantaneous and certain death to do away with the hateful and sometimes bungling services of that functionary. He affords to scientists the means of collecting from and transmitting to all parts of the world invaluable and timely information and warning in regard to passing events, and notably to the state of the weather and the approach and the direction of storms, so as, in many cases, to give time and opportunity for the avoidance of the dangers arising from them.

There is a gentleman (Mr. Robert Davidson) still living in Aberdeen, and whom I have the pleasure of calling my friend, who, forty years ago, constructed an electromotive machine which was tried on the Edinburgh and Glasgow Railway, being the first attempt of the kind; but the speed attained was so far below that of the steam locomotive that the undertaking had to be abandoned, and it had no practical results at the time. And even yet, though there are one or two electric railways in operation on the Continent, there is no indication shown that the present arrangement will be superseded for many years to come.

These are only a few of the numberless benefits for which we are indebted to Electron. But there is one department of public and domestic importance where his services are available, and where they are destined—possibly at no distant

date—to add another contribution to the welfare and happiness of the world: he can be made to assume the character of an angel of light, and to give forth, by self-ignition, an unlimited amount of light, of a beauty and quality, and freedom from noxious effluvia, superior to any artificial light that can compete with it.

There are various ways in which the Magi and other operative assistants have been able to effect this transformation, but the usual and the most efficient is by making use of the intervention of another Genie, whom scientists have much more completely under their command. This Genie, though belonging to a lower order of beings, has within the last hundred years been proved to possess capacities—and has had them practically employed—for the promotion of the power, civilisation, and enrichment of mankind, to an extent that is apt to mislead the ignorant into a belief that he is equal, if not superior, to Electron himself. He may be described as a hybrid, generated by the impregnation of water by Electron, and is invisible, like his father, but, like other beings of semi-terrestrial origin, is continually tending to return to the form and substance of his mother. He is the most extensively known and powerful of a large class of similar spirits, the result of the intrigues of Electron with nymphs of terrestrial lineage, and he derives his energy and strength from his father, and his pliancy and instability from his mother.

Vaporin, as he may be designated, can, by the connivance of men, be generated within strong iron closed vessels; and by the continual and powerful efforts which he makes to escape, and the strength he puts forth while making his escape, he can be made to do almost any kind of mechanical work through the intervention of connecting belts or chains, and of ingenious and appropriate machinery. Well, this Vaporin Genie can be made to rouse the nobler spirit of his father into violent excitement by driving to and fro, across his path, a number of electro-magnets, at the rate of several hundred times in a minute, and thus compelling him, in accordance with a law which is binding upon him, continually to respond to the salaams that are made to him by these electro-magnets. And in the pathway to the magnets there can be placed small gaps or interruptions in the form of some material, such as carbon, which he can pass through only with difficulty. And so, at the points where he has to cross these obstructions, the struggle that ensues betwixt him and the atoms of the carbon is such as to send forth a flash of light that can be compared only to that of the sun itself.

The light produced in this way, then, though it appears to be continuous, is in reality only a succession of rapid flashes, running, as it were, into one. In this magical transformation of electricity into light the part performed by Vaporin is merely that of a mechanical slave, and which could be performed almost as well by the force of gravitation, by wind or water power, or by muscular strength.

Though it has suited the drift of this paper to view Electron as a spirit specially belonging to the Earth, where we can most readily perceive and understand his agency, there can be no doubt that he extends throughout, and fills the universe itself, or at all events that he is co-extensive and homogeneous with light itself, which we know reaches us from the most inconceivable depths of space. And if we can only speculate in regard to most of his operations here, how little can we know, or even conceive, of the entire purposes for which he is employed by the Almighty Architect?

If we can imagine any part of space to be devoid of matter, *there* Electron would exist in his pure and primitive condition as a pure spirit. But with his power of motion (at the rate of 576,000 miles per minute), wherever he comes in contact with the innumerable accretions of matter, whether great or small, so profusely scattered through space, he would become imbued with some minute portion of it; and this, of course, is the form in which we have our experience of him. In some conditions of matter, as in the sun, for instance, through means of the commotions and rearrangements in it which are continually taking place, and in which *he* no doubt plays an important part, he would become imbued with a still larger—though yet inconceivably small—portion of it. And when reflected back from the sun, and now assuming the form of light, his motion would be retarded to one-third, or 192,000 miles per minute. The matter or material undulation thus diffused through space reaches our own planet, its motion being still further retarded by our atmosphere, in a form too attenuated to be identified by the most delicate chemical tests, though recognisable by the spectroscope. Yet, minute as it is, I believe it is continually contributing to the growth, and the health, and the beauty of all living things, as well as producing important changes in the inorganic world.

An ingenious—and it may be said mysterious—instrument, the Radiometer, invented by Mr. W. Crookes, F.R.S., seems to afford confirmation of the idea of the material character of light. It consists of four thin square aluminium plates, weighing about 2 grains, attached to and projecting at right

angles from a slender shaft of the same metal, and kept in position within a glass vessel from which the air is exhausted. The plates are bright on one side and blackened on the other. When exposed to light or to heat the shaft moves with a constant rotary motion, the most probable cause of which seems to be the impetus given by the undulations of light or heat impinging upon the bright sides of the metallic discs, while their dark sides attract and absorb its material (?) constituents, and are thus drawn towards it, so that the bright and the dark sides, thus differently acted on by the light, co-operate together in producing the constant rotation. The friction or resistance of the atmosphere being removed, and the pivots on which the axis moves being very fine, the slightest possible force is sufficient to cause the motion. When we see the tremendous force exerted by so rare and delicate a substance as atmospheric air, when put in rapid motion, we need not be surprised at the effect produced in this instrument by the momentum caused by the immeasurably greater velocity even of what are so imponderable as the waves of light. But strange to say, when the vessel is made as empty as it is possible to be made, by chemical means, the motion becomes turned in the opposite direction—a phenomenon for which, though it may be difficult to account, I would venture to give the following explanation:—As long as any matter remained diffused, probably in the form of aqueous vapour in the Torricellian vacuum of the glass vessel, its affinity or attraction for the light would draw the motion in the direction that has been described; but when this element in the case had been withdrawn, the omnipresence of Electron, with *his* more rapid motion and his preference for the bright side of the metallic discs, would associate the light with himself and attract the bright side of the disc, and thus draw them in the opposite direction from what the light itself did. By entering into the vacuum in the glass vessel, and being released from the compression of the atmosphere, whatever material atoms might be in union with Electron would have their mutual repulsion greatly augmented, and their undulations being thus driven against the bright sides of the discs, so as to cause their movement.

There may be other ways of explaining the action of this curious and suggestive piece of apparatus, but they all tend to confirm the idea of the existence of matter in a radiant and inconceivably minute condition, diffused through space, —in fact, the old and never yet abandoned idea of a universal ether.

That no discovery should have been made hitherto of this radiant form of matter in all the analyses that have been made of atmospheric air is not to be wondered at. There are, indeed, more things in heaven and earth than are dreamed of in our philosophy. Organised and living ova, or germs of many kinds of living organisms, which are now believed—indeed proved—to exist abundantly in the air, and to subserve important functions in Nature, were never, nor can even yet be *visibly*, detected in it. And how inconceivably small must those odoriferous particles be which we recognise by our sense of smell! The particles of the scent of game, or of a man's footsteps, for instance,—consider how minute they must be to be spread for miles across the ground so as to serve as a sure guide to the dog, who is still more highly endowed in this respect than man. How infinitely numerous and minute these atoms must be, and how completely beyond the power of detection, except through the special sense of smell with which God has provided us! And so the electric or "radiant" matter, as it is called by Mr. Crookes, in an inexpressibly attenuated form, is far more likely to have escaped detection. But if we have faith in this very feasible theory of the universal diffusion of matter, we may find ourselves in a better position for seeing and understanding, to some small extent, God's method in the creation and government of the world.

Taking therefore for granted the existence of radiant matter, or ether,—or chaos, as some might call it,—we must also admit the probability that this ether is continuous through space,—throughout interstellar space, we may say, —and that it contains in itself the materials out of which all things were and are made: the stars, worlds, comets, aërolites, and whatever is gyrating and circulating through its vast ocean. If the *proportion* of matter thus held in solution by Electron be inconceivably small, yet as it extends through a space that is, we may say, infinitely great, and is also continually replenished by his solvent power, it may therefore be admitted to be sufficient in amount for the stupendous purposes we have supposed. Out of the matter thus diffused through the ocean of space we can readily believe all things to have been made, the ether itself having been, "*in the beginning*," *created*, but "without form and void," by the fiat of God Himself.

The identity—or rather homogeneity—of the material of which the universal Cosmos is composed may be also inferred from the composition of those aërolites which are from time to time projected, or rather I should say drawn, by gravita-

tion, upon the earth, the substances composing these being found to be quite identical with the components of our own planet. Electron may thus be said to make all the Universe kin, and its inhabitants bone of the same bone, and flesh of the same flesh, as ourselves; although the type and model of their physical organisation may be very different,—indeed must be so,—in conformity with the diverse influences affecting them in respect to gravitation, distance from their central suns, periods of their solar circuits, physical or geological condition, of the planets, and other astronomical elements. But still we are all formed of the same materials, energised and vitalised by the same electric energy, the same light, and the same heat, and are alike the subjects and children under the government of the same supreme Sovereign.

(To be continued).

V. THE ORIGIN OF SPECIES FROM MONGRELS BETWEEN RACES AND OTHER SPECIES.

THE following researches by Herr W. O. Focke, which have appeared in the "Botanische Jahrbücher" and "Naturforscher," though relating primarily to plants, extend in principle to the entire organic world, and must be welcomed as throwing new light on a question still beset with difficulties.

The assumption that new species of plants may in the course of generations be evolved from hybrids has latterly gained increasing probability in consequence of various observations. Still the influence of hybridism upon the origin of species has been hitherto, in general, regarded as quite subordinate. This view Herr Focke combats in his memoir. A careful study of those genera and groups of plants in which numerous transition-forms obliterate the boundaries between the more decided species has led him to the conviction that the ordinary Darwinian view of the origin of species is no longer sufficient. According to Darwin most species have originated by the gradual modification and differentiation of the primitive types. In accordance

with this view the occurrence of polymorphous forms can in many cases be explained by adaptation to modified climatic and local circumstances. Thus the development of the manifold forms in the group *Viola tricolor*, where we find the most distinct forms adapted to distinct local conditions, can be very well comprehended on Darwinian principles. But for the explanation of polymorphism in other groups of plants the principle of variation and selection proves insufficient. As an example we may take the blackberries (black-fruited European *Rubus*). Herr Focke entered upon the study of this group as early as 1857, *i.e.*, prior to the publication of Darwin's great work, with the purpose of detecting, if possible, the process by which species originate. In this rich group, although the individual forms chiefly belong to well-defined races or species, all stages of the process of the formation of species are well represented. The fertility of the different races varies as greatly as the structure of their pollen. In development of characters, in independence, or connection with kindred forms there occur all imaginable differences, so that we cannot conceive of any grade between the variety and the "good species" which is not to be found among the blackberries.

Particular attention must be given to the texture of the pollen in the different forms of blackberry. Some few, such as *Rubus cæsius* (Linn.), *R. ulmifolius* (Schott), *R. tomentosus* (Bœck), have a perfectly well-formed pollen. In others we find a mixture of the granules,—*i.e.*, among sound pollen-grains there is a greater or smaller number of misformed useless particles. Such a degeneration of the pollen may be due to the influence of an unfavourable climate or to defective nutrition. But all the blackberries are characterised by their wide distribution, their remarkable constancy, and their relative independence of soil and climate. Whilst among the blackberries one and the same race readily adapts itself to very different local conditions, we find, on the other hand, on one and the same spot of ground a great number of different races growing promiscuously. It seems, therefore, impossible to assume that the partial failure of the pollen is here a consequence of abnormal vital conditions. We must rather suppose that, as in numerous other cases, the heterogeneous condition of the pollen is connected with a hybridity of descent. That the blackberries do in fact very frequently produce hybrids is certain. *R. cæsius* fertilises all the other species with which it occurs in common, and, like various other species, is always accompanied by its hybrid progeny.

It has often been doubted whether permanent species can arise from hybrids. Hybrids between species mutually remote from each other are often sparingly fruitful. But we often find, *e.g.*, in *R. cæsius* and *R. tomentosus*, in favourable localities, all intermediate links between sterile and fairly fruitful specimens. Observation further shows that with time fruitful races can originate from hybrids of sparing fertility. The original lack of permanence in hybrids, as numerous observations prove, loses itself often entirely in successive generations. Many examples are also known where hybrids artificially produced agree exactly with naturally occurring "good species." Some of the sparingly fruitful hybrids obtained by Herr Focke by sowing the fruits of *R. cæsius* and *R. idæus* cannot be distinguished from the Swedish species, *R. pruinus*, and the Pomeranian *R. maximus*. The locally distributed blackberries are certainly in great part mixtures of races growing in the same district. On the other hand, it is certain that many species and races with mixed heterogeneous pollen cannot be descended from hybrids of known living forms. To be consistent we must still assume that these are also hybrid forms, but that their origin extends far back,—in case of *R. fruticosus*, *e.g.*, as far as the Tertiary epoch. On the other hand, the species with homogeneous pollen may be regarded as of unmixed origin. From the circumstance that the *Rubus* seeds are often carried about by animals, and from their great adaptability, a local mixture of species will easily have occurred, even though under certain circumstances the immigrant forms may have been subsequently displaced by their competitors.

In the struggle for existence vitality and adaptability generally determine the result. Since in this respect, as Darwin has shown, individuals of mixed origin are generally better off than their parents, it is not merely conceivable, but even probable, that hybrid races may survive their ancestry. The disadvantage of a heterogeneous granulation of the pollen is comparatively of little weight.

If we now consider that the majority of our cultivated plants have been produced by crossing, whilst all our art and all the exaggerated influences of soil and climate have not been able to effect much change in given natural species, we shall not be able to resist the conviction that the crossing of species and races has a greater effect in the formation of new species than has been hitherto credited. The prejudice which uncritically ascribes all creative influence to the soil and the climate alone must be overcome.

In order that mixtures may spring up in Nature decided

races must first be formed, as happens by isolation and in-breeding. By crossing the stock attributes of the form are increased, since new properties appear in the hybrids and in their offspring which are added to the sum of the attributes of both parents. A richly varied material is thus obtained by crossing kindred species or races.

On the basis of the following four facts given by Darwin—(1) the greater vitality of mongrels; (2) their variability; (3) the selection of the most suitable types of variable forms; and (4) the survival of the most suitable and highly vitalised forms—it may be maintained that in the rule the specific types of the future will appear among the descendants of mixed races. But as there is no absolute boundary between varieties and species, there can be only a graduated difference between the origin of species from the hybrids between species, and that from the hybrids between varieties.

The views thus developed concerning the origin of species differ only in appearance from those of Darwin. Their import lies merely here,—that they extend the vision of the inquirer who seeks to understand the causes and the nature of Evolution.

VI. THE HEALTH EXHIBITION.

No. II.

On revisiting this display we certainly found not a few objects of interest which we had either overlooked on previous occasions or which had been recently added. At the same time our first impression—to wit, that many of the articles on view had but a very remote and doubtful connection with health, and were consequently here as intruders—was strengthened.

The models representing portions of old London are now complete, or nearly so. But whether, when compared with modern structures, they give us quite as much scope for self-congratulation as is rashly assumed, is, to say the least, not proven. The London which they represent was certainly

unsanitary. But it had this defect, not in virtue of the style of architecture then in vogue, but by reason of the narrowness of the streets, the absence of drainage, the presence of cesspools within doors, and the dirty habits of the inmates. Supposing all these drawbacks removed, there is no reason why houses constructed as in the specimens before us should not be, to say the least, as favourable to health as the most monotonous row of villas or "desirable residences" ever run up by a modern jerry-building speculator.

The "Journal of Science" is not an organ of art, and we have therefore no call to enlarge on the superior æsthetic character of these dwellings of our forefathers. But we may at least ask whether the increasing monotony or uniformity of our domestic architecture and of our modern costumes is not evidence of decreasing specialisation in modern life? We know that this view is not in accordance with the teachings of so eminent an authority as Mr. Herbert Spencer; but we fear it is borne out by facts of many kinds.

In our last notice of the Exhibition we regretted the apparent absence of models showing the evils due to the sin of tight lacing and to the use of high-heeled boots. We are glad to own ourselves mistaken. There are models, in plaster, of the liver of a healthy woman and of the same organ in a wasp-waisted votary of fashion. Along with them are models of the feet of wearers of high-heeled, narrow-toed boots, as compared with the normal female foot. The crippled and distorted members are, in good sooth, ugly to the very verge of repulsiveness. But what must we think of a writer who seeks to argue that these self-inflicted deformities are at bottom the fault of the male sex, and especially of "man doctors"? Yet the writer even contends that such absurdities would vanish if ladies would exclusively consult medical women! Our acquaintance with the profession has been somewhat extensive, but we never met with a medical man who did not protest against tight-lacing and other vagaries of fashion, and who did not carry his remonstrances to the point of occasionally offending foolish lady-patients. The notion that ladies dress to please men we have often heard utterly scouted by the fair sex, as simply a "piece of masculine conceit." Nor do we believe that the normal man, of any grade of culture, admires debility in woman, even if it is wrapped up in the deceitful term "delicacy." When he does it is a sign that wholesome instincts, which may be traced far down the zoological series, have been eliminated from his nature by mistraining and morbid public opinion.

The bulk of the exhibits in the section of dress, however interesting to the historian and the sociologist, have but a very remote connection with health. One thought struck us as we gazed upon the figure and costume of a fop of the early days of George III., now more than a century ago, concerning the evidently thin texture of the garments then worn by men. Very few of us could, save on a few exceptional days in summer, endure the cool clothing of our ancestors. Were they more tolerant of cold than are we, or are the seasons less genial?

Another point is the wide range of colour then permissible in male costumes, as compared with the present narrow limits. But to this we have already referred as a case of anti-differentiation.

In this same dress-department, or gallery, or whatever else it may be named in the modern language of Exhibitionists, we noticed not a few articles interesting enough in themselves, but surely out of place. Thus there was a glass case of dye-wares, unlabelled. We noticed indigo, safflower, turmeric, gall-nuts, catechu, and several of the aniline dyes. But fascinating as are the tinctorial arts, as one of the highest developments of applied chemistry, it is doubtful whether they contribute much to health. It may even be suspected that the dyed or printed garment conceals dirt which the fibre in its original state would betray.

Glove-making is in full operation for the instruction of visitors. But the glove, save in severe weather, is not a sanitary appliance. It is merely an incumbrance with which Mrs. Grundy compels us to shackle ourselves all the year round, but which men of sense are eager to throw off if no one is looking.

Among the long series of grates and stoves for cooking and warming houses, we came upon a model and specimens illustrating the Jameson patent process for coke-burning with utilisation of the volatile products, now allowed to escape into the air. There was no one in attendance, but from the labels we learnt that from a ton of coals burnt there are obtained oils to the extent of 5·65 gallons and 2·7 lbs. of sulphate of ammonia. Concerning the value of the oil it is difficult to hazard even a guess without knowing whether it is rich or poor in benzol, toluol, anthracene, &c. The yield of sulphate of ammonia is not encouraging. To obtain a ton of sulphate of ammonia, worth at present £15 15*s*., there must be burnt nearly 828 tons of coal, and from the returns must be deducted the value of the sulphuric acid required to absorb and combine with the ammonia. If,

however, we consider the enormous quantity of coal yearly converted into coke, it is to be greatly regretted if even so small a proportion of recoverable ammonia should be allowed to go to waste. If the coke obtained is of good quality, and the working cost is low, the process may be, as we heartily hope, remunerative.

In a court displaying objects of art from India—beautiful, indeed, but altogether beside the question—we noticed an interesting exhibit of the tea-culture of India. There are specimens, in pots, of the varieties of the tea-shrub chiefly cultivated in India, and, looking not too happy in their imperfectly-lighted locality; there are samples of the produce, and there is an elaborate map of the empire showing the tea-producing districts, whilst a statistical diagram shows the rapid manner in which the consumption of Indian tea is gaining ground upon that of China.

Amongst the recent additions to the Exhibition is the display of the London water-companies. We see there specimens of the water furnished, models of filter-beds, sections of mains, and, in short, all the appliances for earning heavy dividends. But there is no feature from which an anxious public may learn when the long-hoped-for reform in the Metropolitan water-supply is to be effected, and when we shall no longer be called upon to pay at a higher rate for water because our rents, rates, and taxes have been raised!

In our last notice of this Exhibition we ventured to express our regret that the influence of worry and anxiety in promoting debility could not be brought home to the British public. We find, however, that on August 4th a "Conference" will be opened, in connection with the Exhibition, on the bearings of education upon public health. The Conference is to continue for a week, and its discussions are to be arranged under the following heads:—

1. Conditions of healthy education. 2. Infant training and teaching: *a*. Kindergarten; *b*. Instruction generally. 3. Technical teaching: *a*. Science; *b*. Art; *c*. Handicrafts; *d*. Agriculture; *e*. Domestic economy. 4. Teaching of music in schools. 5. Museums, libraries, and other subsidiary aids to instruction in connection with schools. 6. Training of teachers: under this head will be considered the right professional preparation for teachers in—*a*. Elementary; *b*. Intermediate and higher; *c*. Special and technical schools. 7. Inspection and examination of schools: *a*. By the State; *b*. By the universities; *c*. By other public bodies. 8. Organisation of elementary education. 9. Organisation of

intermediate and higher education. 10. Organisation of university education. 11. Systems of public instruction in various countries.

What will be the conclusions reached we do not venture to forebode. Perhaps we shall be told, on the authority of amateur biologists and psychologists, that anxiety and work under pressure, especially in childhood and early youth, are conducive to health; that "cram" is not merely salutary, but is the only way to train up eminent discoverers and inventors. Or, perhaps, we may confess that we have been going year by year more widely astray, and that our educational arrangements, if the "wonder," are scarcely the "envy" of the civilised world.

VII. THE EXTRACTION OF GOLD.

"And is not gold the god of earth."
P. J. Bailey.

IT is in these days justly and generally considered as a humiliating failure if in any industrial operation we do not secure practically the whole of the valuable products. The farmer seeks to reap and garner in the entire crops which have grown and ripened on his acres. If prevented by bad weather he bewails his bad luck if foolish; and if prudent and energetic, he secures a Gillwell harvest-drying machine. The manufacturer, of every kind and grade, is always on the alert to utilise the whole of the raw materials which enter his factory, and if any waste products are formed he moves heaven and earth to turn them to account, or to extract from them some portion at least which may have a market value.

Instances of the success of such endeavours are familiar not merely to practical men in any department, but to the whole reading public. The prevention of waste and the utilisation of refuse, from coal-tar down to the waste soap-suds of the woollen mills, have served "to point a moral and adorn a tale" almost to weariness.

Such being the undoubted tendency of the age it may strike us as strange—as scarcely in fact credible—that in an

important metullurgical process fully one-half of the substance sought for is, in these days when Science and practice are supposed to walk hand in hand, still allowed to go to waste. It will not lessen the surprise of our readers on learning that the material thus wasted is—gold!

So unexpected is this statement that we think it necessary to present briefly the testimony of mining engineers, assayers, and others of long and special experience. Thus Prof. Jack, Geologist to the Government of the Colony of Queensland, says:—"I believe that from 50 to 90 per cent of the gold contained in some of our complex ores is being lost."

From California, and from the gold-mining districts of America generally, comes substantially the same complaint. Of this we may be convinced on reading over the last Report issued by the Directors of the United States Mint, at Washington. In this Report we find the testimony of Mr. B. Paul, one of the oldest and best mining authorities of California. He says—"As far as California is concerned I am satisfied that not more than 40 per cent of her gold is extracted [*i.e.*, 40 per cent of all contained in the stone that has been treated]. . . . . Our present general system of mining is based upon the idea that gold is mainly coarse, while examination will show that the high percentage is in atoms finer than flour itself. In my experiments gold has been taken up so fine that it would not subside in distilled water in less than from five to ten minutes." He asks further, "Can you save gold of this kind by running water down stream? Can you obtain gold of this kind without minute reduction? Therein lies the secret of high assays before working and small returns after."

Prof. Eggleston, one of the most eminent metallurgical chemists of America, calculates the loss at "between 50 and 60 per cent" of the total gold present in the ore operated upon.

Mr. C. S. Dicken, F.R.G.S., in a paper read in March last before the Royal Colonial Institute, quoted the amount of gold actually contained in the "Disraeli pyrites" from the Charters Towers District, Queensland, as being on an average 4 ozs. 14 dwts. 13 grains per ton. But the quantity of gold actually obtained from this ore on the present system is only $1\frac{1}{2}$ ozs., or a loss of 70 per cent. Another Queensland sample, Mr. Joske's "Ravenswood pyrites," gives on assaying 2 ozs. 18 dwts. 19 grs. of gold to the ton. But on the ordinary system of working it cannot be treated at all at a profit, and is hence lying idle.

In short, summing up all the facts and all the other evidence bearing upon the question, we can only re-affirm the statement made in a former volume of the "Journal of Science," that "when treating the most tractable of the sulphurets, battery amalgamation (*i.e.*, the process at present in use in California and Australia) does not secure more than 45 per cent of the gold."

We may here glance at the change which has latterly come over gold-mining and gold-finding in general. When the auriferous fields of California and Australia were first opened up, the precious metal was obtained in nuggets of different sizes, and in grains or sand, which, though small, were distinctly visible to the naked eye. These grains and nuggets were obtained by washing, and subsidence from the sands, gravels, and other *detritus* resulting from the weathering of auriferous rock. The process was simple, and required little of either capital or metallurgical skill. But these washings or diggings have been practically exhausted. Whether similar deposits may or may not exist in Central Africa, in New Guinea, or in unexplored parts of South America, is not here the question.

The gold-miner has now to go to work in a more systematic manner. Quartz reefs—*i.e.*, beds of quartz rock containing auriferous pyrites—occur sometimes near the surface, but sometimes only at considerable depths, and, contrary to a popular notion, these reefs do not necessarily become poorer the deeper the miner descends, but very frequently richer. Hence the ordinary practice is now to sink down to or below the reef, to drive levels, break up the stone, and send it up to the surface for further treatment.

This gold-stone, however, differs not merely in the percentage of gold contained, but in other features which have a very important bearing upon the process of extraction. Where merely quartz rock and iron or copper pyrites accompany the gold and silver, the process is comparatively simple; but when, as is often the case, the sulphurets of antimony, lead, zinc, &c., occur, there is great difficulty, waste of the mercury used, and a loss, as we have seen, of the greater part of the gold demonstrably present in the stone.

The method of extracting the gold from the stone may be found described in full detail in every text-book of metallurgy; still, for the better understanding of what has to follow, it is here described in outline. The lumps of quartz rock are ground up, by means of stampers with water, to such a degree of fineness that it can pass through a sieve

containing 225 apertures to the square inch. It is then ground up with mercury, and washed over a series of amalgamated copper plates and flannel filters, by which the gold is supposed to be arrested. In reality very much of it, as we have seen, escapes. The powder of the rock is far too coarse; many minute particles of gold—locked up, so to speak, in the centre of these particles—escape the action of the mercury altogether. Much of the gold, too, amalgamated or not, floats away on the surface of the water, and is lost. Hence Locke, probably the first authority on the subject, though he did not see his way to doing away with the use of water in the extraction of gold from quartz stone, calls it "the greatest robber."

Further, by grinding up with the wet mass no small portion of the mercury is rendered "sick," as the technical term is. In this state it is incapable of readily combining with metallic gold or silver, and floats away on the surface of the water in a fine film. This sickening or killing of the mercury is very much promoted if a little oil or grease from the machinery finds its way into the amalgamation-pan. If anyone wishes to see what sick mercury is, he need only grind a little of this metal up in a mortar with water and fine sand or earth. If he continues this process long enough he will find that the metal loses its tendency to run together in globular drops, and can only be collected together with great difficulty.

The water also facilitates the action of sulphurets of antimony, &c., upon the quicksilver. Sometimes, indeed, where these ingredients are abundant, the whole, as the miners term it, gets into "a mess," from which neither the gold can be extracted nor the mercury recovered on paying terms.

In consequence of the deficient yield of many of the kinds of quartz rock, and the practical impossibility of working others at all, some of the mines in Queensland have been abandoned, and others are carried on at a profit far below what they ought to yield. At the same time the "tailings" or residues of ore which have been ground and submitted to the amalgamation process have accumulated to the extent of many thousands of tons. These tailings still contain a very fair proportion of gold, as is proved by the assay, but they cannot on the ordinary principle be reworked at a profit.

In consequence of this annoying state of affairs Mr. W. Pritchard Morgan, a North Queensland mine-owner, and Mr. J. Needham Longden, an Australian mining-engineer

and metallurgical expert, came over to London about a year ago to consult with the leading British and Continental metallurgists, and to devise, if possible, some more excellent way. After many, and we may say costly experiments, they came upon a totally new process, which in the opinion of the best judges, and, what is more, in actual trials on the large scale, bids very fair to get over the difficulties which we have above enumerated.

The inventors propose, in the first place, to comminute the ore not in a wet state, but perfectly dry. The pulverising process is effected not by means of a battery of stampers, but by means of a "Jordan" pulveriser. This apparatus acts not by grinding or stamping, but by impact or concussion, something after the manner of a Carr's disintegrator. The stone is reduced to a powder as fine as flour, so that it passses through a sieve of 8100 meshes to the square inch, or, in round numbers, forty times as fine as is done in the old process. Hence all the loss dependent on the circumstance that much gold remains still locked up within the grains or fragments of quartz or pyrites is got rid of. The use of water is dispensed with entirely, and though the pulverising is so much more perfect it is effected at an average cost of 8*s*. per ton, as against 16*s*. 6*d*. per ton by the stamping process, so that here already there is a saving of 8*s*. 6*d*. per ton.

We come next to the amalgamation. The mercury is applied dry and hot. The ore, reduced as above to an impalpable powder, is passed upwards through a column of heated mercury 30 inches in height, and during this passage it is kept constantly distributed through the mercury by an ingenious self-acting apparatus. The details of this part of the process can not be intelligibly described without the use of plates, or, better still, of a working model. We can merely say that the ground ore is fed into a hopper at the top of a revolving tube. Passing down this it is centrifugally forced into the mercury, and would then, in consequence of its lower specific gravity, at once rise to the surface. To prevent this too rapid escape it is constantly agitated in the mercury by a set of revolving blades. These can be adjusted in their number, in their speed of rotation, and in the angle at which they are set, so that the pulverised ore can be kept in contact with the heated mercury for a longer or a shorter time, according to the quality of the stone which is being operated on. A steam jacket outside the pan maintains the mercury at the temperature desired. When, finally, the ground ore reaches the top of the column

of mercury, it meets a strong blast of air which blows it across the concentrating chamber. "The particles of sand fall in different parts thereof in accordance with their specific gravity, the light waste being conveyed by the air-current to a waste-pipe which conducts it away."

It will, of course, be evident that as any particle of gold combines with the mercury to form an amalgam its specific gravity is increased, and it falls down to a conical receptacle in the bottom, where it can be let off from time to time as convenient.

It is scarcely necessary to insist on the vast advantages of this method of amalgamation over the old wet process. The mercury, hot and dry, comes into immediate and close contact with every particle of gold or silver present, which can hence scarcely escape without amalgamation. The water is no longer there to interfere or to carry away fine films of gold upon its surface, the mercury does not become sick, and the whole process is completely under control.

We must, however, beg leave to make one suggestion: so far, as we perceive, the inventors purpose using pure mercury. We submit that, especially in cases where antimony sulphides, &c., are present, they would find it advantageous to use the sodium-amalgam, first proposed by Mr. W. Crookes, F.R.S., and which has done good service in the hands of metallurgists in various parts of the world. The quantity of sodium which has to be added is so minute that it would neither appreciably increase the working cost nor modify the specific gravity, the fluidity, &c., of the mercury. Consequently the mechanical arrangements for distributing the ground ore through the mercurial column would remain the same.

Passing, however, from considerations of what should or must be, to the records of actual experience, we find the teachings of theory fully borne out in practice. In conjunction with Messrs. Jordan, Son, and Commans, the mining engineers, of 52, Gracechurch Street, the gentlemen previously named have had an extensive plant for the extraction of gold erected at Stratford Market, and have there put their process to the test of work. It has been found that the "Disraeli pyrites," mentioned above as yielding in Queensland, by the old process, 1½ ozs. of gold, or 30 per cent of the contents as per assay, gives by the new process 4 ozs. 5 dwts. 11 grains, or 91 per cent—a clear gain of nearly 3 ounces. Mr. Joske's "Ravenswood"

pyrites, mentioned above as found to be incapable of treatment in Queensland, yielded 2 ozs. 12 dwts. 20 grains, or 89 per cent of its total contents. This increased yield of the precious metal is obtained, further, not at an increased but at a diminished working cost.

In addition to obtaining a greatly improved production at a reduced outlay, there are certain collateral advantages which must not be overlooked. In the first place water is dispensed with. This, in a country like Britain, may seem a trifling point; but in many gold-fields—in Australia, California, and South Africa—water is often very scarce, and the introduction of a process in which it is not required will be no small boon to the mining communities.

Another consideration is that the process is self-acting. The amalgamation apparatus may be locked up in a strong room, and will go on with its duty undisturbed. Thus there is neither opportunity for pilfering, nor are the men exposed to the fumes of mercury.

Though this invention emanates from persons more directly connected with the gold industry of Queensland, we must not for a moment suppose that the process is applicable there only. In other parts of Australia, in California, Mexico, &c., the very same conditions prevail, and the same waste is going on, for which we have here the remedy. It must especially be noted that though many samples of quartz from the Wynaad, and other districts of India, are found when assayed to contain fair, and even large, percentages of gold, yet the mines in question are not remunerative. We are surely warranted in believing that this new process is the condition needed to make these mines commercially successful.

It is estimated that at present the annual output of gold for the whole world is £20,000,000. Now if we leave out of view the inferior stone, the waste ores, and the accumulated heaps of tailings, we may form some idea of the value of a process which, if generally put in practice, must increase this yield by at the least 25 to 30 per cent.

The process has been patented in all countries where gold-mining is likely to be carried on. The patents for the United Kingdom (No. 5235, November 5th, A.D. 1883, and No. 5236, of the same date) are taken out in the respective names of Thomas Rowland Jordan, and of Thomas Rowland Jordan and John Needham Longden. To these specifications we must refer our readers for further particulars.

In pronouncing this new process one that will make an epoch in the metallurgy of the precious metals as signal, doubtless, as that due to Sir H. Bessemer and to Messrs. Gilchrist and Thomas in the treatment of iron, we must not omit to point out that we have taken every precaution to assure ourselves of the *bona fide* character of the invention. With fair play it will especially add greatly to the prosperity of Australia and of India. It deserves, therefore, a full and a candid examination.

ANALYSES OF BOOKS.

The Wonders of Plant-Life under the Microscope. By SOPHIE BLEDSOE HERRICK. London: W. H. Allen and Co.

THE author of this ably-written work treats in succession of the beginnings of life,—an ominous subject,—of single-celled green plants, of fungi and lichens, of liverworts and mosses, of ferns, the physiology of plants, of corn and its congeners (among which are here included the orchids), "the microscope among the flowers," pitcher-plants, and insectivorous plants.

It will be evident, from this sketch of the contents alone, that Miss Herrick has sought not to furnish a systematic treatise on Botany, but to give a number of detached pictures illustrating some of the most interesting portions of the science.

In the first chapter the writer discloses her point of view, which is scarcely that of the modern biologist. She speaks of an "Intelligence which can and does fill every portion of this infinity of worlds with full, perfect, and exquisite life." We might, perhaps, ask Miss Herrick how she has ascertained that every portion of the universe is filled with life, and by what standard she measures perfection? She speaks of "the subtle scepticism of the human heart," of "the world in its innate unbelief," and of Science as being "its own antidote." Does it require one? Passing from these reflections, which we submit savour more of a tract than of a scientific treatise, she gives a clear account of the vegetable cell, and of its contents, protoplasm, "responsible for much bitter and rancorous warfare." But whose is in truth the responsibility?

This chapter concludes, perhaps with doubtful relevance, with certain comments on the relations between man and the lower animals. Says Miss Herrick:—"It is hard to find anywhere a deep chasm which separates our race from the myriad forms of life beneath if we ignore man's spiritual nature. On the physical side man is undoubtedly allied to brute nature, as he is on the spiritual side to the Divine." But if we grant a "spiritual side" to man, can we deny it to the lower animals? There is probably no faculty or emotion present in ourselves which in a lower grade is demonstrably absent in them. The very same arguments used in favour of man's continuance after death may be advanced also on behalf of "our poor relations." If the phenomena of Spiritualism prove that man is not solely material, they have shown the same concerning dogs and birds. The

introduction of this passage is the more to be regretted since it has absolutely no connection with the "wonders of plant-life."

The succeeding chapter, on single-celled green plants, is well written and admirably illustrated, most of the figures being drawn from Nature, we presume, by the author herself. But at the conclusion she raises the question as to the nature of the "vital force," and speaks of the theistic solution as "too simple, perhaps, for those who are bent upon looking back through millions of ages to the fiery gas out of which, they say, not only our worlds and systems of worlds have been developed." But such simple solutions cut off Science at its very root.

The chapter on fungi and lichens deals, among other low forms of plant-life, with bacteria, the muscardine of the silk-worm, the parasite which destroys flies, Listerism, and esculent fungi. *Phallus impudicus*, which is here misprinted *Phajus*, is strangely described as being of great beauty. The function of the lichens in decomposing rocks, and thus aiding in the great process of soil-making, has been omitted.

In discussing the ferns Miss Herrick speaks of "the most perfect manifestations of vegetable life." So, then, unless perfection admits of degrees, all plants are not "perfect," as was intimated in the beginning of the book.

In the chapter on corn and its congeners we find an Agassizian idea :—"The dim prophecies that have been struggling for utterance through all the language of vegetable life here find their fulfilment." Indeed, throughout all the work, we find no decisive evidence that the author accepts the principle of Evolution.

The fecundation of the orchids is described at some length. But Miss Herrick is too sweeping when she says—"To begin with, they are epiphytes or air-plants." She knows perfectly well that the orchids of cold climates grow in the soil like ordinary plants. On the same page we read :—"In Darwin's charming little volume upon the fertilisation of orchids, multitudes of forms are represented with an astounding number of variations of structure ('contrivances' he calls them, though he ignores the Contriver), to insure the cross-fertilisation of these plants." Perhaps it might have been more judicious if Darwin had written "quasi-contrivances"—a term which would have harmonised better with their origin on the principle of Natural Selection, and would have evaded the above-cited quirk on the part of one who owns herself so largely his debtor. We are very glad to find that Miss Herrick makes no attempt to deny hybrid fertilisation. She writes :—"There are many instances where a hybrid is produced by the fertilisation of one variety, species, or even—in rare and exceptional cases—genus by the pollen of another."

In a very interesting chapter on the pitcher-plants the author writes—"for a living representation of the mighty *Dinornis* of geologic times was subsequently found. If these words imply

that a living specimen of the Moa has been found, Miss Herrick is under a mistake. But a more important error is the assertion that "a development in one direction is invariably accompanied by a correlative development in another." Fossils have been found whose dentition and extremities would respectively assign them to widely different places in the Animal Kingdom.

A very curious fact is mentioned in the account of the pitcher-plants. A species of moth, *Xanthoptera semicrocea*, both in the adult and the larval state, possesses peculiarities which enable it to overcome the dangers encountered by other insects in the tubes of *Saracenia*.

In the following chapter, devoted to the more typically carnivorous plants, the author returns to Darwin, and prefaces an acknowledgment of the treasures of fact which he has given to the world with the words "however strongly we may and do dissent from his conclusions taken as a whole." This judgment is not very different from that which we must pass upon the work before us. As a statement of facts we can and do recommend it, but its theoretical portions are certainly not on a level with the science of the day, or in harmony with what we believe to be the truth.

Longman's Magazine. No. XVIII. April, 1884. London: Longmans and Co.

This number contains a "New Theory of Sun-spots," by Mr. R. A. Proctor. The author holds that the spots are regions of cooling and not of greater heat, and are probably due to the action of forces working from within expansively. If this view is correct a season of sun-spots must be a season of diminished heat radiation from the sun, and we on earth—and the denizens, if any, of the other planets—must suffer from cold.

If below the luminous surface of the sun there are regions of darkness, we may ask how does this fact agree with the nebular hypothesis? If the sun has been formed by the gradual condensation of a "fire-mist," surely its interior should be the hottest portion, or at any rate not the coldest.

It is further recorded here that on a certain occasion there was observed "an ejection of matter, solid or liquid (or if vaporous, then of great density), at velocities so great that the ejected matter could never return to the sun. . . . . In this case the ejected matter is now travelling, with velocity constantly diminishing, but never to be entirely lost, into the depths of interstellar space."

If the sun is thus in the habit of squandering his substance,

throwing out instead of receiving meteorites, his exhaustion as a heat- and light-giving centre may be perhaps a few million years nearer than has been surmised.

"A Pilgrimage to Selborne," by T. E. Kebbel, is thoroughly imbued with loving memories of Gilbert White. It is sad to think what changes have been wrought on the flora and fauna of even that peaceful district. Sad, too, that anyone unless a great naturalist should bear the title of "Lord Selborne." But we do not give peerages to men of Science in "this our highly-favoured country."

Mr. T. E. Kebbel writes:—"For it is not only the closeness of his observation and the extent of his knowledge in Natural History which delight us in his pages. The tone of satisfaction and contentment which they everywhere breathe; a love of and devotion to Nature, unbroken by that strife and trouble which nowadays penetrate to the remotest recesses of our island, ... contribute at least an equal share of the pleasure which they inspire."

Twelfth Annual Report of the United States Geological and Geographical Survey of the Territories. A Report of Progress of the Exploration in Wyoming and Idaho for the year 1878. Part I. By F. V. Hayden, United States Geologist. Washington: Government Printing-Office. 1883.

This bulky, elaborate, and richly-illustrated volume contains the report of Dr. C. A. White on the Invertebrate Palæontology of the regions explored, that of Orestes St. John on the Geology of the Wind-River District, and of S. H. Scudder on the Tertiary Lake Basin of Florissant, Colorado. The second, or zoological section, embraces the report of A. S. Packard, jun., on the Phyllopod Crustacea, and the report of R. W. Shufeldt on the Osteology of certain American Birds, especially the Tetraonidæ and Cathartidæ.

We must first, however, notice Dr. Hayden's Preface, from which it appears that the present Survey must be regarded as definitely at an end. The sum voted by Congress for completing the publication of the results was exhausted by the end of June, 1882, and five volumes remain awaiting completion. This is much to be regretted. At the same time men of Science all over the world must admire the scale on which the Survey was conducted and the liberality shown in the distribution of its publications.

Perhaps the most interesting of the reports in this volume is that of the Palæontology of the Florissant Basin, probably the

richest locality in the known world for fossil insects. In a single summer it has yielded double the number of specimens which Heer obtained from the Œningen beds during thirty years. On comparing the produce of the two localities we observe a striking difference as regards the distribution of the different orders. In both the Orthoptera, Arachnida, Myriapoda, and Lepidoptera are very poorly represented; the Hemiptera are nearly equal in both; but whilst 48 per cent of the Œningen fossils belong to the Coleoptera, this order at Florissant includes only 13 per cent. The Diptera form 30 per cent at Florissant, and 7 at Œningen; whilst the Hymenoptera amount to 40 per cent in the former, and only 14 in the latter.

Among the Hymenoptera 70 to 80 specimens, representing about 30 species, have been found of wasps. A *Polistes* is remarkable as retaining traces of a greenish blue metallic tint. Another case of the survival of colour occurs in a specimen belonging to the Chrysidæ.

Of ants about 4000 specimens have been distinguished. Ichneumons, both small and large, are well represented, and prove the species of insects in which these parasites could oviposit.

One butterfly, in fine condition, has been described as *Prodryas persephone*. Two more diurnals appear, distinct from any living genus, but nearly allied to *Prodryas*.

The number of the Diptera—especially Culicidæ, Chironomidæ, and Tipulidæ—is remarkable, and proves that had man existed in the Tertiary epoch he would have found it by no means a golden age.

Among the Coleoptera two-fifths of the whole belong to the Rhyncophorous series, in striking contrast to what is observed in the European tertiaries. The water-beetles are not numerous, and there are no large *Dytisci*, as at Œningen. Silphidæ, Histeridæ, Dermestidæ, and Ptinidæ are few, pointing to a not over plentiful supply of animal refuse. Coccinellidæ and Telephoridæ are also scarce, whence we should argue that plant-lice cannot have been very abundant.

The Lamellicornes—or as our American friends prefer to call them, after the French fashion, Scarabæidæ—are moderately numerous; but until we know what proportion of them belong to the flower-haunting, and what to the dung-feeding group, we can draw no conclusion as to the presence of ruminant animals.

It is remarkable that few land- and fresh-water-shells have been found. There is a species of *Planorbis* with a thin shell and always damaged, a *Physa*, and a single specimen of a bivalve. Eight fishes have been found; also a sparrow-like bird (*Palæospiza bella*), with bones and feathers tolerably complete, a plover, and a finch. The plants are very numerous, and from 90 to 100 species have been determined by M. Lesquereux.

From the character both of the animals and the plants, the climate, at the time of these deposits, is supposed to have been

similar to that of the shores of the Mediterranean. Nearly all the species which have been thoroughly studied are of a tropical —or at least subtropical—nature. Their position in time is considered to be in the later Eocene or early Miocene.

Dr. Shufeldt, in his memoir on the "Osteology of the Cathartidæ," which are now considered to form a family distinct from the vulturine Falconidæ of the Eastern Hemisphere, describes all the American genera and species. The question whether a second species of condor (*Sarcoramphus*) exists, or if the specimens so named are merely immature forms of the ordinary *S. gryphus*, is still undecided.

Bulletin of the Philosophical Society of Washington. Washington: 1883.

Among the papers which have been read before the Society is one on "Recent Investigations of the Lighthouse Board on the Anomalies of Sound from Fog Signals." The author exposes the common error that sound is always heard in all directions from its source according to its intensity or force, and according to the distance of the hearer from it. He proves, for instance, that a sound is sometimes inaudible when comparatively near at hand, and becomes distinct when the hearer removes to a greater distance. Again, whilst sound is generally heard further with the wind than against it, yet under certain circumstances the reverse is the case.

Mr. J. J. Woodward, the retiring President, read an exceedingly interesting address on "Modern Philosophical Conceptions of Life." As the subject of this paper will probably be considered at length in our pages at no distant date, we shall not here enter upon its discussion.

Mr. C. A. White and Mr. Antisell both conclude that on great plains Artesian wells have failed to be of any practical value for the irrigation of land.

Mr. Elliott Coues read a paper on the "Possibilities of Protoplasm," which has also been republished under the title "Biogen: a Speculation on the Origin and Nature of Life. Dr. Coues upholds the existence of a special vital principle which he contends is the cause, not the result, of the peculiar properties of protoplasm. He challenges men of Science to show what is the chemico-physical difference between living and dead protoplasm. He defines "soul" as that quantity of spirit which a living body may or does possess. "Spirit," again, he takes to be immaterial, self-conscious force, whilst life consists in the animation of matter by spirit. The substance of mind he terms *biogen* or

"soul-stuff," and defines it as spirit in combination with the minimum of matter necessary to its manifestation.

Hence it would seem, according to the speaker, that spirit may combine with matter in various proportions.

This paper led to a discussion in which some strange views were brought to light.

Mr. Doolittle maintained that in biology, just as in chemistry, in physics, and in astronomy, we must have what we still lack—a measure. He asks, "Is there more life in two mice than in one mouse? In a horse than in a mouse?" The term "automatic," as used by Mr. Coues, he considers "a confession of biological ignorance."

Mr. Powell pointed out that in the reasoning of Dr. Coues there was a fundamental and fatal error, "the axiom that the whole equals the sum of all its parts had been assumed to be true qualitatively as well as quantitatively." He himself "admitted neither force nor a vital principle, but merely matter in motion. Three relations were always to be borne in mind, *viz.*, quantity, quality, and succession, whereas the physicist falls into error by considering only the quantitative relation."

Mr. Gill thought there was a tendency on the part of biologists ignorant of philosophy, and philosophers ignorant of biology, to make a distinction between organic and inorganic matter, and to call in a vital force.

Mr. C. S. Busey read a memoir on "The Influence of the Use of High-heeled Shoes upon the Health and Form of the Female, and upon the Relations of the Pelvic Organs." The author contends that, in addition to the distortion of the foot, there is danger of increased obliquity of the pelvis, which may be an important factor in the causation of certain disorders of the female reproductive organs.

Mr. Gill proposes a modification in the arrangement of the insectivorous mammals. He unites the typical Insectivora and the Dermaptera in one order, but regards them as sub-orders. He distributes the true or typical Insectivora into two groups characterised chiefly by the molars.

The volume closes with an "Annual Address," by Mr. W. B. Taylor, who takes for his subject "Physics and Occult Qualities." We have here a destructive criticism of kinematic theories. The kinematist tells us that action at a distance is a metaphysical impossibility, whilst the dynamist assures us quite as positively that action at no distance is a demonstrated physical impossibility. Is there, then, no motion at all? We are reminded of Newton's dictum that action at a distance is a manifest absurdity; but we hear less frequently that, in his "Optics," the same philosopher subsequently asked "Have not the small particles of bodies certain powers, virtues, or forces, by which they act at a distance?" Not unjustly does the author remark, "There is no mystery in the world of mind that is not fully

paralleled by mysteries as bewildering in the world of matter."

The reflection, however, naturally suggests itself that the author, as well as Mr. J. J. Woodward and Mr. Elliott Coues, and, on the other hand, their opponents, may be regarded as travelling beyond the legitimate boundaries of Science, and raising issues with which the human intellect is unable to grapple.

The Utility and Morality of Vivisection. By G. Gore, LL.D., F.R.S. London: Kolckmann.

This valuable pamphlet is, as we learn from the title-page, "issued by the Association for the Advancement of Medicine by Research." It need scarcely be said that we are gratified at any manifestation of life and activity in a body of which so very little is to be heard.

The author begins by defining the term "Vivisection" as used in his title. It is to include "those experiments to which Bestiarians object, *viz.*, all kinds of painful ones on animals." One misfortune is that they consider, or at least call, *all* experiments upon animals "painful."

With an amount of patience and self-control which is truly admirable, Mr. Gore wades through the cavils, the quibbles, the illogicalities of the Bestiarians,—matter of such a nature that we can scarcely understand how it can be believed, much less uttered, by men and women in their sound senses,—and exposes its fallacious nature. He shows that hatred of Science altogether is to a large extent a ruling principle with these fanatics. He reminds his readers that at one time it was a violation of "public sentiment" to watch the motions of the heavenly bodies. He shows that if the results obtained by the physiologist are sometimes doubtful, such is the case also even in the simpler and easier sciences, in physics, in chemistry, and in astronomy itself. Yet such uncertainty is held to be a reason not for discontinuing experiments and observations, but for multiplying them under varied conditions. The uncertainty of results in physiology is merely somewhat greater in degree than in the other sciences.

The Bestiarians, it appears, complain of the existence of true physiologists who work simply for the love of truth, without any thought of the "good of mankind." This, Mr. Gore shows, is merely a case of the division of labour. One man discovers, another applies. Why should such a division be objected to?

The fanatics further assert that "we have splendid and rapidly

developing methods in hundreds of other directions, " and that if vivisection were utterly stopped the result would be "the finding of far better and more certain means of discovery." Can the utterers of such froth name even one such means? If they can, why do they keep silence?

Agitations generally are not marked by truthfulness; but the Anti-vivisection movement, wherever it exists, has been above all others characterised by an excess of falsehood in every form. The prominent part which England has taken in this hubbub has certainly contributed to lessen the already slight respect in which she is now held abroad. For the country which is the very head-quarters of "sport"—in other words, of the infliction of pain for pure amusement—to object to comparatively few and generally slight inflictions of pain in pursuit of knowledge, seems to other nations the *ne plus ultra* of inconsistency and hypocrisy.

We can conscientiously recommend Mr. Gore's pamphlet, and we trust it may have a wide circulation. Greater activity is called for among men of Science. The tactics of the enemy have been to go on throwing dirt, in the hope that some of it at least will stick,—to pour out invectives, well knowing that a falsehood may be uttered in few words, whilst its exposure will often necessitate many.

Sunspottery; or, What do we Owe to the Sun? A Popular Account of the Spots on the Sun, their Phenomena, Nature, and Cause, with an Inquiry into their alleged Influence upon the Weather, Famines, Pestilences, Commercial Panics, &c. By J. A. Westwood Oliver. London: Simpkin, Marshall, and Co.

We do not know whether the author of this pamphlet is responsible for the inelegant, and in our humble opinion superfluous, word "sunspottery." His conclusion is given very unmistakably. He remarks that the sun's activity waxes and wanes periodically, that his radiation undergoes a corresponding variation, that our meteorological conditions which depend upon the solar heat fluctuate accordingly, and that these events more or less directly related to the accident of weather exhibit a like change, are each and all assumptions supported only by evidence of the weakest kind; and can we be expected to hang our faith upon a chain of reasoning every link of which is defective?" He adds, in conclusion, "We may say, then, that an impartial examination of the evidence available leads to but

one conclusion, which is that sunspottery is *not* what it is represented to be, but is, for the most part, humbug."

This inference Mr. Oliver draws from the admittedly conflicting character of the evidence brought forward. The grand difficulty is that periods of heat and cold are not felt simultaneously over the whole earth, but are confined within arbitrary limits. The mild winter we have had in Europe, accompanied by a correspondingly hot summer in the Southern Hemisphere, led many people to believe that the earth was passing through a wave of heat, whether connected with the number and magnitude of sun-spots or not. But lo! our mild winter was accompanied by an exceptionally cold one in North America. The other season Britain, France, Switzerland, Italy, and Western Europe in general, were shivering in a cold, wet summer, whilst Austria, Hungary, Russia, and Turkey basked in unclouded sunshine. The attempt, however, to trace periodicity in biological phenomena seems to us eminently praiseworthy. If such cycles are found, their connection with cosmic phenomena is a subsequent task.

ERRATUM.—In our June issue, p. 366, line 16 from bottom, *for* "could digest things" *read* "could not digest things."

CORRESPONDENCE.

*** The Editor does not hold himself responsible for statements of facts or opinions expressed in Correspondence, or in Articles bearing the signature of their respective authors.

TECHNICAL TRIALS.

"An Old Technologist" would reform Technical Trials; but while he sees a few flaws of the actual, he has keener sight for the possible flaws of the possible. He thinks that of all Law proceedings the least satisfactory are Technical Trials. I question not their badness, but their eminence of badness. Let him hear trials for libel or slander, and he may think them

"By merit raised to that bad eminence."

Let him next hear trials for conspiracy, wherein the conspiracy is itself the crime, and the right of eminence may be again transferred (*sic*); then let him hear the mock form of trial for "contempt of court,"—"if form it may be called which form has none,"—and again he may transfer the palm. Then let him ask all classes what is their *practical* trust in law and its administration, and he will get a unanimous opinion that is hard to reconcile with the established facts,—that Law is perfect reason, the wisdom of the Bench, and the honour of the Bar. I dare only say that I have failed to find them: don't destroy my remaining faith in the jury; even juries are mortal, and need reform. Whether it would be good reform to let "the Court" appoint experts as assessors to judges, I doubt. "Technologist" admits the Court's incapacity to decide questions of Science: would he let the same ignorant Court decide among scientific men? Heaven preserve the Homœopath defendant if the Court should choose an Allopath assessor! Woe betide the patentee under an assessor without faith in the Patent Laws! And if the assessor is to "expound to the jury the conclusions of Science," and to be exempt from examination and cross-examination, one might guess that these conclusions are either so proved that they may be taken from a text-book, or so disputable that they may be the very matters disputed.

"An Old Technologist" fears that technical language can be understood only by the technical; but a trial needs little technical language, and that little can be explained. Among botanists a botanist speaks of *Myosotis*, *Ranunculus*, and *Bellis*, but among common folk he speaks of forget-me-nots, buttercups, and daisies.

In your June number Mr. Fraser turns "incandescent-lamps" into "glow-lamps," and he may get rid of "arc-lamps" by calling them "spark-lamps."

For free Government trial by jury is almost as essential as a House of Commons. Juries have less prejudice and more sense than judges, but they need reforms :—

1. Abolish all exemptions.
2. Let the jury list be chosen by the parliamentary voters.
3. Let three jurors be named by agreement of parties, or, in default, by lot, and let four more be named by lot, seven making the jury.
4. Treat them with honour: let them be "the Court," and let judges be their assistants.
5. Abolish unanimity, and after an hour's discussion let the majority decide. Let the minority record their opinion, and let it be the only ground for fresh trial.
6. Make the jury judges of law as well as of fact.
7. Give the jury power to stop insulting and idle cross-examination by the Bar, and to fine silly jokes by the Bench.

NOMIKOS.

June 7, 1884.

[We inserted the communication of "An Old Technologist' in order to ventilate a grievance which scientific men feel very strongly. Into the general question of the defects of any other than technical trials, or into any "reforms" of the courts of justice, we have no right to enter.—ED. J. S.]

HYLOZOISM AND HYLO-IDEALISM.

FOR so interesting a writer as C. N. to fall into the error of asserting that "whatever philosophy the future has in store must be built on the seemingly (!) narrow foundation" of *the part containing the whole* is indeed a misfortune for the philosophy she (?) so ably advocates, since it may tend to a hesitancy on the part of some "mystical mathematicians and transcendental chemists" in accepting her leadership through these realms, with which, lying "beyond thought and perception," they "can have nothing to do."

The "Autocentric ideal," though "wide and lofty as thought, and clear and vivid as sensation," is based upon the assumption that "the world, as we know it," "is produced within that 'crumpled pocket-handkerchief' called the cerebrum." Now, as the cerebrum is part of the world, this is tantamount to saying that the whole (unknown) is produced by, or contained in,

a part (of the unknown), and this is gravely set forth as an explanation of the mystery of the Universe.

Such loose and shallow thinking forms but a poor platform whence to sneer at the sublimity of the Cosmos, or to raise doubts as to our having "very much to do with thoughts and perceptions which shine dimly through long spaces of years."

The fact is this: we must either admit matter (cerebrum, world, and all) to be real, in which case the infinity and sublimity of the Cosmos, however "nauseous" such themes may be to C. N., must also impress themselves upon students of that Cosmos as real, in proportion to the amount of their observation (and "nauseous," surely, in inverse proportion thereto); or, we must give up matter (cerebrum and all), and assert our own immaterial existence, as the centre, if you will, of an immaterial environment (to whom such assertion will doubtless be immaterial).

But to plead a material brain as the procreator of a phenomenal world, and to deny that world the materialism we arrogantly usurp for that brain, and on such a foundation to plant the philosophy of an "Autocentric ideal," is very effectively to invalidate the claims of such a philosophy to one moment's consideration or attention, either on the part of Spiritualists or Materialists.

F. P. L.

Brixton, June 3, 1884.

SELF-PURIFICATION OF RIVERS.

With reference to the article by "Argus," in your May number, I wish to call your attention to an additional instance of a polluted river becoming purer as it flows.

A Mr. G. Rydill, in the preamble to the specification of a patent (A. D., No. 391), states that he is well acqu'anted with the River Calder, which at a certain part is so foul that fish cannot live in it. But after flowing for about four miles, and passing over three wears, it becomes so much purified that fish make their appearance along with other forms of higher life, both animal and vegetable.

Inventor.

NOTES.

The Royal Microscopical Society, after careful deliberation, have decided upon admitting ladies to all the privileges of fellowship, attendance at the ordinary meetings excepted. The large collection of microscopic objects, amounting to some thousands of slides, will during the winter months be examined and arranged by a committee of experts, and rendered available for consultation by the Fellows. Owing to the absence of a catalogue the treasures in the possession of the Society are almost unknown, but the cabinet contains many specimens—the work of Quekett, Bowerbank, and other pioneers—which, apart from their intrinsic merits, must always possess considerable historical value.

Dr. B. Placzek ("Popular Science Monthly") has collected citations from the Talmud to show that the old Jewish writers were keen observers of Nature, and had ideas akin to Darwinism. Joseph Albo, in the fifteenth century, suggested the thought of compensation, or interchange of relations, in a hypothesis that cattle are defective in teeth because so much of the tooth-stuff goes to horn. Other writers noticed that the integrity of the comb of the cock had much to do with its masculine potency, and that other birds suffer in spirit and vigour when deprived of their ornamental appendages. Passages are quoted that point to the thought that the difference in mental gifts between man and (other) animals is only quantitative.

(Those who assert that the Semitic mind is radically unscientific will do well to reconsider their position. Altogether the scientific attainments of antiquity were much greater than we commonly suppose. They would have been greater still had it not been for Socrates and his school.)

Dr. H. Macnaughton Jones, in a recent work, declares:— "After nearly twenty years of constant teaching in a large school of medicine, and some years of experience as a University Examiner, I have come to the conclusion that for future success in life the test of examinational proficiency is a most fallacious one": and again, "I can conceive no more certain plan for the physical ruin of thousands of the youths of a country than the system of capitation fees from results of examination."

In North America the cold during the past winter has been exceptionally severe. At Knoxville, lat. 36° N., the minimum was $-26{\cdot}7°$ C.; whilst at Malta, in the same latitude, it was $+5°$.

M. Andries ("Ciel et Terre") contends that hail is formed during ascending whirlwinds.

M. Hirn ("Comptes Rendus") concludes that we must count by millions of degrees in estimating the internal temperature of the sun.

M. Hugo Gyldén, in a communication to the French Academy of Sciences, maintains that the relative distances of the principal planets in their primordial state must have been much smaller than they are at present.

The Bestiarians have held an "International Congress" to protest against the crucial experiment by which M. Pasteur proposes to demonstrate the efficiency of his vaccine for rabies. Mrs. A. Kingsford, M.D., who made herself very prominent on this occasion, exclaimed that M. Pasteur was not justified in "torturing thousands of animals" with the object of abolishing so "very rare" a disease. The "thousands" when translated into the language of sober reason shrink to 40! As for the "rarity," we must remember that 21 persons died of hydrophobia in the Department of the Seine within twelve months!

A belief prevails in certain rural districts of France that the direction of the wind on Palm Sunday will predominate during the first half of the year. M. de Touchimlekt has studied the case, and finds that in a series of fifteen years the belief was justified seven times and failed eight. In general it holds good if the wind on the day in question blows from the south-west, but not if the current is north-easterly.

Mr. S. E. De Morgan ("Light") points out several errors in the utterances of Koot Hoomi as given by Mr. Sinnett (see "Journal of Science," 1882, pp. 405, &c.).

The occurrence of the Egyptian cobra (*Naja Haje*) has been demonstrated by M. Valery Mayet, who has captured a fine specimen not far from Oued Leben.

M. Mussett ("Comptes Rendus") shows that the supposed influence of light on the anatomic structure of the leaves of *Allium ursinum* is non-existent.

Dr. T. Tommasi ("Cosmos les Mondes") notes that the thermic constant of thallium is exactly the mean of the thermic constants of potassium and lead, the two metals which it most resembles in its chemical character.

M. Trouvelot, of the Observatory of Meudon, after observing the shadows thrown by the faculæ on the penumbræ of sun-spots, suggests that the brilliant light emitted by the faculæ, and perhaps the entire light of the sun, is generated at its surface, the presence of the coronal atmosphere being, perhaps, necessary for its production.

American and Continental papers are still discussing the bearings of the Huddersfield lead-poisoning case of 1882. It is deplorable that inventors do not seek to devise some safe substitute for lead as a material for water service-pipes—surely a nobler task than to devise new means for the destruction of life and property, and to play into the hands of the vilest of criminals!

The anæmia of brickmakers, well known in Italy, and recently observed at Bonn, is caused by the presence of an entozoon, *Anchylostomum duodenale*. The disease is contracted by drinking water from muddy pools.

M. G. Rolland ("Comptes Rendus") shows that since the beginning of the Tertiary epoch the Sahara has been dry land, save a relatively limited region at the north-east which was covered by the Eocene Sea. At the end of the Miocene all the north of Africa was above water, and since then, during the Pliocene and the Quaternary, the outline of the south shore of the Mediterranean has not sensibly varied.

It is to be feared that, as far as the lighting of towns is concerned, the electric light has been snuffed out in Britain by recent legislation. Its only immediate future must be in manufacturing establishments where the current can be produced and distributed without crossing any public road.

We are happy to find that the study of the physical sciences as compared with that of classics is on the increase in Scotland.

Mr. H. H. Smith ("American Naturalist") maintains that three distinct cats have been confounded under the name of jaguar (*Felis onça*). In the normal form the black spots are arranged in groups of five or six each on an ochre or tawny ground. In the *Onça pintada* or *cachorro* the spots are smaller, and scattered evenly without grouping, whilst in the *tigre* grouped spots occur on a brown-black ground. The hunters declare that all these varieties "breed true," and that crosses are rare.

According to the "Lundy Index" nitrogen protoxide is naturally evolved from the shales of the Tioga Hill, in California.

Mr. J. B. Armstrong, of the Botanic Garden, Christchurch, New Zealand, believes that red clover in that island is becoming modified in its structure, so as to admit of fecundation by means of insects which do not visit it in England.

M. Aug. Charpentier ("Comptes Rendus" after a series of experiments on the perception of colours, arrives at the following laws:—The perception of differences of illumination is the more easy the less the refrangibility of the colours. For one and the same chromatic intensity the perception of differences in illumination is the same for all saturated colours, and for an equal visual intensity the perception of the differences of illumination is the same in all colours.

According to the "American Naturalist" the "moths from the Great Basin have a peculiarly bleached and faded appearance, probably resulting from the light soil and bright skies of Utah and the adjoining territories."

A Professor Dulles, speaking possibly in the interests of dogs and dog-worshippers, denies the very existence of hydrophobia!

An anti-vivisection meeting of ladies and clergymen has been held at Edinburgh. The usual absurdities were repeated.

It is not generally known that Pascal opposed the Copernican theory, not as scientifically erroneous, but as tending to heresy.

MM. Grehant and Quinquaud ("Comptes Rendus") have demonstrated that the blood of the hepatic and splenic veins, and of the vena porta, contain always more urea than the arterial blood, or the venous blood of the limbs and the head.

M. Chevreul contends that the three colours of Young—red, green, and violet—cannot be accepted as primitive until it is demonstrated why yellow should be excluded.

Prof. Haeckel has presented the collections which he made during his recent tour in Ceylon, &c., to the University of Jena, where they are now arranged in the "Zoological Institute."

D. Amate proves experimentally that the chemical action of light is restricted within certain limits and temperature.

The "Medical Press and Circular" asks whether Mr. Jesse has become converted to reason, and withdrawn from the Bestiarian camp? If so, we may have hopes even for Miss F. P. Cobbe and Ouida.

The establishment of a biological station at St. Andrews is strongly urged, and is to be decidedly recommended.

Dr. G. Wyld ("Light") tells us that just as Slade was persecuted by the Agnostics, so Eglinton is threatened and persecuted by the Theosophists.

Prof. E. D. Cope ("American Naturalist") divides men into three classes with reference to the practical use they make of their intellect. These types are the mercantile, the literary, and the scientific.

According to the "Calcutta Englishman" Dr. V. Richards has succeeded in producing the cholera artificially in swine.

TWENTY-FIRST YEAR OF PUBLICATION.

THE JOURNAL OF SCIENCE,

AND ANNALS OF

ASTRONOMY, BIOLOGY, GEOLOGY, INDUSTRIAL ARTS, MANUFACTURES, AND TECHNOLOGY.

(MONTHLY, FORMERLY "THE QUARTERLY JOURNAL OF SCIENCE.")

POST TENEBRAS LUX

Vol. VI. (THIRD SERIES)
No. CXXVIII.

AUGUST
1884.

CONTENTS.

LONDON:

2, HORSE-SHOE COURT, LUDGATE HILL.

Where Communications for the Editor and Books for Review may be addressed.

PRICE ONE SHILLING AND SIXPENCE

THE

JOURNAL OF SCIENCE.

AUGUST, 1884.

I. A DESCRIPTION OF THE PROCESS OF "HYDRAULIC MINING" IN CALIFORNIA,

WITH EXPLANATIONS CONCERNING THE ORIGINATION OF GOLD-BEARING ALLUVIUM THERE, AND ELSEWHERE.

By George O'Brien.

OUR knowledge of the primitive operations of the aboriginal inhabitants of the globe in pursuit of gold is barely traditional, as we are only aware that from very early times the precious metal was collected and highly prized by them, and that they chiefly extracted the visible gold, which existed in prodigious quantities on, or closely beneath, the surface of the earth, and of its being particularly abundant in Asia and Africa. But we can draw more positive conclusions as we survey remains of the rude but effective contrivances used by them in later, but still remote, periods, with full evidence as to the extent of their operations, in the numerous perpendicular shafts located at short distances from each other, over large areas of auriferous gravel in India, as well as from precisely similar memorials of ancient workings which remain also further demonstrations, in the abandoned "hill diggings," and shifted beds, and beds of rivers, in Peru, South America, flowing between the sea and coast ranges of the Andes, descending in a north-easterly direction to the River Amazon, and that their much-coveted and enormous productions were the accumulated riches of the Incas, transferred as spoils of war to their Spanish conquerors in the sixteenth century. And for

similar explorations in the same class of depositions we have the experiences of our own times, and which explain by comparison all the previous cperations alluded to. Thus in the year 1849, after the cession of the northern portion of Mexico to the United States of North America, the rich mineral district of California was at once invaded by hardy and intelligent bands of mining adventurers from all parts of the world, who, with little other means at their disposal but pick, shovel, and pan, soon fell upon the productive bars of rivers and rich ravines where the gold was trapped, derived from its original birthplaces, where it had been sparsely disseminated, to be dispersed by the subsequent disintegrations and denudations of the mountains themselves, and deposited in a disengaged form for the first comer; and so perfect were sometimes these concentrations, in certain localities where water once streamed, that, divested of its earthy matrix, the cleansed pure metal was found deposited, detained by its superior specific gravity, on the bare rock, and only hidden from vision by a slight covering of vegetable mould. In this manner, as an example of such concentration, a "pot" or "find" (in mining parlance) to the value of £10,000 was collected in a space of 15 square yards, or within the limits of a particular "mining claim," at the foot of Mokulumne Hill, in a southern county of California, soon after the territorial transfer from Mexico. And in search of such locations we must account for the numberless shafts which still exist both in India and Peru, and sometimes sunk within a few feet of each other, passing through the alluvium to a depth of 40 feet to the bed rock.

These mining adventurers soon extended their explorations over the other recently acquired territories, and built Virginia city, the capital of Montana, with the gold derived from the alluvium of a river channel which they excavated; and its inhabitants were the founders of an institution called the Vigilance Committee, with "Lynch law," and by it ruled supremely for many years. But their surface diggings, by the manual operations alone of multitudes, were soon exhausted in every direction, and then their energies and powers of invention were dedicated to discover and explore deeper and more permanent depositions, along the western slopes of the Sierra Nevada, the Andes of the Western Territories, and which originally were without doubt several miles higher than they are at the present time,—probably 20,000 feet above the sea-level,—and of which, or whatever superior elevation they formerly had, the greater portion of

it has already been removed, by the continuous natural action of centuries, to form there, as elsewhere, the plains and prairies of the earth, burying and diverting by the mutation the ancient river system, whose sources of supply were consequently extinguished by the removal of these altitudes. These denudations and subsequent depositions have been caused by alternations of temperature and combined action of air, water, and time since the creation of the world; and powerful demonstrations of these transformations instruct us in all directions, if we care to observe them. Thus in "Little Cottonwood" ravine, in the Wasatch range of mountains in Utah Territory, lie isolated, in the centre of the valley, huge masses of metamorphic granite, some blocks of which weigh individually thousands of tons, and were dislodged from the hills—which on either side are of limestone formation—with no visible granite in them, having been undermined by the removal of their pulverised basis by denudation, and which is the material now forming the table-lands, the foundation of Salt Lake city. The blocks of granite, having alone resisted the atmosperic changes, were precipitated into the valley beneath, and the Mormons are now constructing their cathedral church from these granitic remains.

The melting of the snow which formerly capped all these ranges of mountains furnished the water that once flowed in the extinguished channels of ancient rivers, and whose now diverted waters were also the powerful agent to assist in causing these marvellous alternations; and by the means of hydraulic mining we can advance our feeble knowledge on the subject. These mighty changes have gradually been accomplished, and the accumulated denudations of the mineral zones have defended themselves by stratas of crystallised silicates of quartz of various thicknesses, and thus in places beneath such system of defence, or by their own concretion, have preserved in many localities a thickness of from 500 to 600 feet of conglomerate; but without this necessary cementation its further removal is very certain when again attacked by water. And an example of this continuous process is very observable in "Death Valley," Lower California, where a width of about 100 miles has been filled up from the hills to the gulf of same name, invading and occupying its former bed; and this activity is still proceeding, and a temporary formation of table-land above it is in course of removal, although already overgrown with forest trees, which are toppling over the side which is being attacked. But eternal snow now only covers a small portion of these

sierras, and a period of comparative repose may be expected, as the distribution has already been far advanced by the excessive reduction of the mountains.

The deep and extensive depositions which I now attempt to describe attracted the early attention of the mining adventurers, and were called "hill diggings," but not being properly understood were therefore not immediately operated upon, and remained in abeyance, whilst the lower, richer, and more manifest alluvials endured. They were designated "blue gravel," the colour being due to the action of sulphuret of iron and other salts, the cementing auxiliaries requisite to form the hard conglomerate, and on exposure to the atmosphere changes colour to yellow and violet, losing also its firmness by oxidation.

The "great blue lead" is another important mining term, and designates the alluvium found reposing in a well-defined channel on the bed rock, being the well-worn path of an ancient river; and it is obvious that the material in these channels should be richer than the general mass beyond their limits.

"Rim rock" is the boundary line of the banks of the old channel, and, like the bottom, is well worn and corrugated by the running water into cavities and "pot-holes," where the force of the stream eddied. The width of these channels varies from 60 to 400 feet, and the cement near the rim and bottom is always richer than elsewhere. The wider and deeper channels generally course from N. to N.W. The richest and most explored belt of gold bearing alluvium in California lies between the South and Middle Yuba Rivers, commencing near Eureka, in Nevada county, and extends downwards to Smartsville and Timbuctoo, in Yuba county, a distance of 40 miles, and from amongst snowy mountains the country falls gradually from where the ravines or cañons are cut by the actual rivers, which are 2000 feet beneath the auriferous gravel and region near Smartsville, and 2000 feet above the Yuba River, where snow is unknown, and near its terminus the ancient river bed courses more westerly than it does above it, and crosses Yuba below Timbuctoo, where the auriferous depositions disappear. The whole distance of 40 miles has been ransacked by the earlier adventurers, and around the village of Timbuctoo was a centre famed for its wonderful yield of gold, obtained chiefly in the ravines, in holes and depressions in the bed rock. These hollows detained the concentrations of the denudated alluvium from the altitudes, and were generally closely beneath the surface, and by such guidance and means of discovery the miners

traced the gold up the ravines to their sources in the lofty mounds and deposits, or hills of cemented conglomerate, near Eureka, in Nevada county, and by constructing canals from a higher level began the new system of "hydraulic mining" and washing, and gradually extended their operations over the area of the metallic zone mentioned, of 40 miles long by 20 wide, using the Yuba River below Timbuctoo to receive and discharge the tailings, or refuse from their operations. The result in gold was considerable, but the system is from its violent nature difficult to control, by presuming to handle and remove such huge depositions in order to collect the richest material. The idea was bold, being an anticipation of Nature's operations; but the equitable disposal of the "tailings" in a cultivated country is impossible, as the silt runs down the rivers, creating banks and bars in their channels, obstructing navigation and agricultural arrangements.

General Description of Hydraulic Mining.

The first work to be accomplished, after calculating that the amount or value of the material to be operated upon is sufficient to guarantee the cost of the undertaking in general, is the construction of a canal or canals, to convey the requisite volume of water from the fountain-head, and of sufficient elevation to command the ground to be worked upon, having also in view the levels of the necessary tunnels and shafts as outlets for the discharge of the gravel through them, these being engineering operations requiring much skill and labour to avoid useless after cost.

Aqueducts of considerable elevation have to be constructed across deep valleys, and the speculation is at all times problematical, as the ground cannot be properly tested until the water arrives upon it, and disputes may arise between the shareholders of the canal and the mining company, ending frequently in the one devouring the other, unless the two interests be quickly amalgamated.

The starting-point should be the lowest level, or "Bed rock," on the white cement in the ancient channel, which is probably the original silt collected in it, and is harder than the conglomerate above it, which is more easily removed. The courses of these beds can be easily traced by landmarks and indulations, and occasional exposures of the bed rock at low levels; also trial shafts are sunk in various places in search of it, to a depth of 100 feet, passing through blue gravel. The grades of these beds are not steep, being

from 10 to 40 feet per mile as of an ordinary river, and the calculated thickness of the alluvial conglomerate is about 600 feet in many places across the ridge between the South and Middle Yuba River across the Columbia. The power of the water for the operation is dependent on a given volume deposited in a reservoir, and at sufficient elevation above the points of discharge, as on this depends its effectivity to tear down the gravel. It is delivered to the miner by huge pipes made of wrought iron, and laid down to follow the curvatures of the surface of the ground; and the pipe I now treat of, belonging to the Excelsior Water Company, has a diameter of 40 inches on a length of 6000 feet, and 20 inches on the rest of its length of 3000 feet, being 9000 feet in all; and this large pipe forms an inverted syphon across a valley, following on the gravel, to the top of the hill into the reservoir.

These pipes offer advantages over wooden aqueducts for spanning chasms, and also to avoid coursing the sides of valleys; being also cheaper to construct in general, and less liable to accidents from fire and storms, and have the convenience for conveying the water from point to point, as the work of excavation advances, necessitating the removal of portions of the aqueduct forward. The watershed, or reservoir, of the Excelsior Company embraces the valley of the South Yuba and its affluences, and the entire cost of its eight amalgamated canals was 750,000 dollars.

The rainfall during three years in the mountains averaged 49 inches annually, whilst the medium in the same period did not exceed 20 inches in the plains beneath. The height of the reservoir above the tailing, or Yuba River, is 393 feet; and the height of the head above the floor, or outlet sluice-tunnel, of the Blue Gravel Mining Company was 197 feet.

The exact quantity of water required to wash every class of gravel is difficult to estimate, but no quantity or pressure would be excessive if properly arranged. The measurement of water is effected by miners' inches, by allowing it to flow from the reservoir of the seller to the purchaser through a box 10 or 12 feet square, with divisions to obtain a quiet head, with a slide or opening capable of adjustment to any required measure: thus an opening of 25 inches by 2 inches, with a quiet head of 6 inches above the middle of the orifice, would give 50 inches, or about 89,259 cubic feet of water, flowing during ten hours per day, being an amount necessary for a first-class operation. The capability of the Excelsior Canal, in rainy seasons, reached to a delivery in twenty-four hours, to the various mining companies, of 21,120,000 cubic

feet of water, or 8000 miners' inches; and the value of the water paid for by the Blue Gravel Company in forty-three months, ending November 9th, 1867, was 157,261 dollars, being at the rate of 15 cents of a dollar per miners' inch: and the proportion of water used to wash down 989,165 cubic yards of gravel was 17,074,758 cubic yards, or $17\frac{1}{4}$ cubic yards of water to 1 cubic yard of gravel; and when at work the quantity of gravel daily moved was 1298 cubic yards, and the estimated cost to move one cubic yard of gravel was 5 and 7-10th cents of a dollar. But in the face of contingencies the Blue Gravel Company moved 1,000,000 cubic yards of gravel in four years, or at the rate of 250,000 cubic yards per annum, and the cost of washing each cubic yard stands thus:—

	Cents.
Cost of water, at 15 cents per miners' inch	5·77
Cost of labour, gunpowder, sluices, and superintendence	16·10
	21·87

Or $21\frac{3}{4}$ cents of a dollar per cubic yard.

Thus the gravel should contain gold to the value of 22 cents of a dollar per cubic yard to cover cost, and the value of the gravel referred to ranged from 20 to 45 cents per cubic yard; and the cost of work done in shafts and tunnels, in the said Blue Gravel Company's Mining claim, reached 100,000 dollars. But with the cost of the necessary canals, paid for by the Excelsior Water Company apart, the total cost amounted to about 1,000,000 dollars, and we must note that the latter company sold water to other mining companies.

The gross yield in gold of the Blue Gravel Company in four years was 837,399 dollars, and in the year 1866 the returns from the Blue Gravel Company paid all the costs of the developments; but in 1867 assessments were paid by the owners to meet the deficiency arising from the cost of sinking two new shafts, and driving fresh tunnels on the lowest levels, which evidently contain on the bed rock the richest concentrations.

In smaller mining adventures of this description, involving less capital, large profits have been made in the gold-bearing zone treated of, by also not having invested in costly canals, which would not have repaid the latter investment; and thus it is evident that the water companies are dependent blindly on the prosperity of the miners.

I will now more minutely describe the actual mining operations:—The mining ground being selected, a tunnel is

projected from the nearest and most convenient ravine, so that the starting-point on the bed rock towards the face of the ravine shall approach the centre of the material to be removed at a gradient of 1 in 10 to 1 in 30. The dimensions of such tunnel are usually 6 feet in width by 7 in height, and continuing in contact with the hard river-bed, for the greater ease of excavation, collection of gold, and conservation of quicksilver amalgam.

These tunnels vary in length from a few hundred feet to a mile, and some of the longer ones occupying from one to seven years in execution, at a cost of from 10 to 60 dollars per foot of frontage. The tunnel of the Blue Gravel Company, with length of 1358 feet, cost in labour alone 70,000 dollars, but it could now be driven for 35,000 dollars, as skilled labour is cheaper now than then. The grade in this tunnel is about 12 per cent, and the end of the tunnel is designed to be 170 feet of elevation, and reaching to a point beneath the surface of the gravel which is being operated upon, and where a shaft or incline is sunk to or through the bed rock or gravel, until it intersects the tunnel. The object of this laborious operation is obvious, as the long tunnel becomes a sluiceway, and through the whole length of which sluice-boxes are laid, for the double motive of carrying off the material and saving the gold, and for this purpose a trough of strong planks is placed in the tunnel, $2\frac{1}{2}$ feet wide, and with sides high enough to contain the stream. The pavement of the trough is generally laid of blocks of wood 6 inches in thickness, cut across the grain, and placed on their ends, to the width of the sluiceway. The wooden blocks are usually alternated with sections of stone pavement, the stones being set endwise, and in the interstices between the stones and wooden blocks quicksilver is distributed, and as much as 2 tons of this metal is required to charge a long sluice. The water in the canal is brought by aqueducts, or other means, to the head of the mining ground, having an elevation of 100 to 200 ft. above the lowest level of the mining ground, and is finally conveyed to it by iron pipes, sometimes sustained on a strong incline of timber.

These pipes are of sheet iron, of adequate strength, rivetted at the joints, and measure from 12 to 20 inches in diameter, and communicate at the bottom with a strong prismatic box of cast-iron, on the top and sides of which are openings for the adaptation of flexible tubes, made of very strong fabric of canvass, strengthened by cording, and terminating in nozzles of metal of $2\frac{1}{2}$ to 3 inches in diameter. From these nozzles the streams of water are

directed against the face of the gravel to be washed, exercising incredible effectivity.

The volume of water employed varies of course with the work to be done; but it is not uncommon to see four such streams acting simultaneously on the same bank, each conveying from 100 to 600 inches of water per hour,—1000 miners' inches being equal to 106,600 cubic feet of water per hour, constantly exerting its force under a pressure of 90 to 200 pounds to the square inch, varying with the height of the column.

Under the continuous action of this enormons force, aided by the softening power of the water, large sections of the gravelly mass are dislodged, and fall with great violence, the *débris* speedily disintegrating and disappearing under the resistless force of the water, and is hurried forward in the sluices to the mouth of the shaft, down which it is precipitated with the whole volume of turbid water. Boulders of 100 to 200 lbs. in weight are dislodged and shot forward by the impetuous stream, accompanied by masses of the harder cement which meet in the fall, and by the concussion from the great boulders the crushing and pulverising agency required is found to disintegrate it. The heavy banks, of 80 feet and upwards, are usually worked in two benches, the upper never being so rich as the lower, and also less firm, and therefore worked away with greater rapidity.

The lower section is much the most compact, as this stratum on the bed rock being strongly cemented resists great pressure, and even sometimes the full force of the streams of water, until it has been loosened by gunpowder or other explosives. For this purpose adits are driven in on its foundation-point of from 40 to 70 feet and more from the face of the bank, and drifts are extended at right angles therefrom to a short distance on each side of the adit, and in these drifts a large quantity of gunpowder is placed (from 1 to 3 tons), and fired at one blast, having been previously built in with masonry. And in this manner the compact conglomerate is broken up, and then the water easily completes its work. Sometimes in the soft upper strata the system of tunnels is extended, as in a coal-mine, by cross alleys, leaving blocks which are afterwards washed away, and then the whole mass settles, and is disintegrated under the influence of water. The wooden sluices in the tunnels already described are often made double for the convenience of "cleaning up" one of them, whilst the other remains in action. The process of cleaning up is performed according to the quantity and richness of the material worked upon,

at intervals of twenty to forty days, and consists in removing the pavement and blocks from the bed of the sluice, and then gathering all the amalgam of gold and rich dirt collected, and replacing the blocks in the same way as at first. Advantage is taken on this occasion to reverse the position of the blocks and stones when they are worn irregularly, or substitute new ones for those which are worn through. The mechanical action of the washing process on the blocks is of course very rapid and severe, requiring complete renewal of them once in eight to ten weeks. Some miners prefer a pavement of egg-shaped stones set like a cobble-stone flooring, the gold being deposited in the interstices. Most of the sluiceways are, however, paved with rectangular wooden blocks, with or without stones as described. Standing at the mouth of one of the long tunnels in full action, any person unaccustomed to the process is struck with astonishment, amounting almost to terror, as the muddy mass sweeps onward, bearing in its course the great rolling boulders, which add their din to the roar of the water, the whole being precipitated down a series of falls, at each of which it is caught up again by new sluices of timber, lined like the first, and so onwards and downwards many hundreds of feet until the level of the river is reached, at a distance of about a half mile or more from the mouth of the first tunnel.

At each of these new falls of 25 to 50 feet the process of comminution begun in the first shaft is carried on, and a fresh portion of gold obtained. Rude as this plan of saving gold appears to be, more gold is procured by it than by any other method of washing yet devised for this process of work, and the economical advantages obtained by it cannot be surpassed, as it would be impossible to handle such vast quantities of material in any other way, and we can compare the cost of washing and handling a cubic yard of auriferous gravel by it as follows:—

	Dollars.
By manual labour with the pan	15·00
" " with rocker	3·75
" " with the long tom ...	0·75
By the hydraulic process...	0·15

But this process, even if effective or profitable as a mining operation, may be prejudicial to the interests of the general public, if conducted on a large scale, as the vast quantity of material which it so suddenly removes is merely shifted into the shallows beneath, to be re-distributed by every freshet to

points lower and lower down until it reaches the sea-coast, creating bars at the mouths of rivers in its course, and changing the hydrography of harbours—as it has done with the Bay of San Francisco by its silt.

The hills behind, torn up and washed by the gold miner, are abandoned as desolate and irredeemable ; and the costly canals, constructed with peculiar conveniences for mining purposes, eventually fall into disuse from being too expensive to maintain or alter for general agricultural uses.

130, Fenchurch Street, London, E.C.,
May 14, 1884.

II. OBSERVATIONS ON TWILIGHT.

WE must first here complain of the want of a word which exactly covers our meaning. We might have said "Observations on Dawn," but this term is by a general convention limited to the glow in the sky which precedes sunrise, excluding that which follows sunset.

THE remarkable atmospheric phenomena which were witnessed in most parts of the world during the last winter have, as our readers know full well, given scope for much discussion ; but, oddly enough, for some time no one raised the necessary preliminary question touching the normal colouration of the sky at morn and eve. At last the thought occurred, both to theorists and observers, that without a precise knowledge of this normal colouration all inquiry as to the abnormal display of the last season was in want of a firm basis. Were the aërial pageants described by "Our Special Correspondents" merely an intensification of what has always been witnessed under cloudless skies, or were they something novel and totally different ?

It might indeed seem strange that, in a scientific age like the present, hundreds of observers were not at once prepared with an answer ; but the observations required can be made to advantage only under skies fairly clear from cloud and

smoke, and in situations where the heavens are visible down to the horizon.

Fortunately two sets of extended and systematic observations of the evening and morning skies are in existence. The one series, published in the "Zeitschrift der Œsterr. Gesellschaft für Meteorologie," was made by Dr. G. Helmann, in Spain, during the years 1875 and 1876.

The author made, in the first place, determinations of the position of the sun at the beginning of the morning, and at the end of the evening twilight. He finds that the altitude of the sun below the horizon at the end (or the beginning in the morning) of astronomical twilight, though generally assumed at 18°, is not constant, but has a very distinct yearly period with a maximum in winter and a minimum in summer. This altitude is also greater for the morning than for the evening twilight, and is closely connected with the relative moisture of the air with which it increases. This relation to moisture determines probably the difference between the winter and the summer twilight, as well as for that between morning and evening. The same consideration will doubtless explain the fact that the depth of the sun below the horizon for evening twilight is greater in high latitudes than in low ones. Thus at Athens the yearly mean is 15·9°; whilst in the south of Spain and on the Atlantic, between 18° N. lat. and 20° S. lat., it is 15·6°. It is also smaller in inland districts than on the nearest seas. These points, however, require to be confirmed by further observation.

Not less important than these measurements of the sun's altitude are the observations made on the physical progress of the twilight in which a great number of physical changes are combined to form a typical image. In Spain, at least, the optical phenomena of twilight form two distinct classes, that of the dry and that of the rainy season. These two differ, however, mainly in intensity, so that we may here confine our attention to one form,—that of the wet season,—as the more splendid and the more manifold.

When the sun has still an altitude of 4° there appear along the entire horizon various faint colourations. In the west there is a delicate yellow of about ½° in altitude, and above that a light green of about 1°, whilst above the sun, up to about 50°, the sky is of a shining light blue, of a rather elliptical form. In the east there appears a deeper green, of only 1° in altitude and 60° in azimuth.

When the sun descends to 1° the green on the western horizon reaches an altitude of 20° without becoming more

intense; beneath this green, along the horizon, is an orange-yellow stratum of about 3°, which on its lower side begins to change into rose, brownish red to purple-violet, and extends from south to north. In the east the green becomes more intense, and rises up to 6°, whilst immediately on the horizon there appear faint rose-colour and yellow of about 2° in altitude.

When the sun has gone down the green in the eastern sky extends up to 9°, the yellow to 6°, and the full rose to 4°. The latter colour is more intense on its lower side, and fades away into an ill-defined stratum of deep steel-blue of ¼° in altitude—the beginning of the earth's shadow.

In the western sky the rose-colour has decreased; the yellow takes a more orange tint; the green increases in intensity, whilst the pale blue descends to about 45°.

Important changes now take place in the east. When the sun is about ¾° below the horizon the deep steel-blue appears as a segment of about 1° in altitude and 75° in azimuth. The superimposed rose has become deeper, and extends to 10°, whilst the yellow and green have generally entirely disappeared.

As the sun sinks deeper the rose colour takes a more purple tone, and the margin of the dark segment turns violet, whilst this segment itself becomes lighter, and changes from a steel-blue to an ash-grey. These colourations of the eastern heavens above the earth's shadow are known as the "counter-dawn," and vary in their altitude with the moisture of the atmosphere, extending higher as it increases. On an average the boundary arc of the earth's shadow can be observed up to an altitude of 15°; the segment then extends in azimuth for 150°, when the sun is 4·6 below the horizon. The superincumbent rose disappears generally at an altitude of 25°, whilst the sun has descended to 4·9 below the horizon. The so-called "civil twilight"—as distinguished from the astronomical twilight—is then at an end.

In the western heavens the orange-yellow band of 3° in altitude remains unaltered; the brownish red below it disappears entirely, and the green extends only to 8°. When the sun is 3·8° below the horizon the sky takes a rosy cast up to 25°; this colour becomes more decided and extends, so that a rosy red segment of about 40° is superimposed upon the lower strata, and attains its greatest intensity of colour when the sun has sunk to 4·3°, at the spot where the first appearance of colour was observed. This first rosy light sinks rapidly downwards, whilst the lower strata vary little, and when the sun has sunk to 6° it has in general quite disappeared.

Now the arc in the western sky which bounds the illuminated segment begins to be very distinctly perceptible. When the sun is 6° below the horizon it is about at the altitude of 75°. For 170 degrees along the western horizon extends the orange-yellow stratum, of $2\frac{1}{2}°$ in height; above it lies a green band of double the width, whilst the rest of the illuminated segment is a whitish blue. The boundary arc sinks rapidly downwards, and when the sun is 10° below the horizon it is scarcely as many degrees above. Sometimes a second, but fainter, rosy light can be seen in the western sky, but of less extent and shorter duration than the first. When the sun has sunk to $11\frac{1}{2}°$ every trace of red colour has vanished from the western sky, and the sharply-defined luminous segment hastens down to the horizon.

Still with the descent of this segment the phenomenon has not always reached its end. There sometimes occur later whitish colourations in the western sky, and whitish segments, which, however, never display any trace of colour. On one occasion a luminous appearance of 6° altitude was observed when the sun was already 23° below the horizon.

The phenomena observed during the dry season in Spain are inferior to those described, both in intensity of colour and in extent.

The phenomena of the dawn observed in Germany differ widely from those recorded in the south of Spain. In the latter country the phases are more distinct than in Germany. The succession in time is more definite, and the strata of different colour are more distinctly marked off from each other; the boundary between the light segment and the dark sky is very decided.

On the other hand, with the exception of the counter-dawn, the duration and the extent of the colouration are greater in Germany. As regards the colours, there prevails the difference that in Spain green is almost invariably seen in all shades, which is rarely the case in Germany. On the other hand, in Germany the red colourations of the Spanish heavens take a more flesh-coloured and purple tone, and the violet colours seem deeper. Further, in Spain there exists a greater difference between the twilight phenomena of summer and winter than in Germany.

In England we need scarcely say that, as a rule, the phenomena are too much complicated by smoke and cloud to admit of useful study.

At an earlier date—in 1864—Prof. von Bezold made a careful study of the phenomena of ordinary twilight, and published his results in "Poggendorff's Annalen" (vol. cxxiiii.,

p. 240). His memoir, however, though inserted in a journal so constantly consulted by men of Science, appears to have passed unnoticed. Of this oversight the notices of the phenomena of last winter gave abundant proof. Had Prof. von Bezold's paper been referred to the world would have seen that the displays in question were simply an intensification of the normal evening afterglow, and would not have rhapsodised anent electric discharges, the north light, &c. The author's memoir would further have afforded a starting-point for a more complete study of the progress and the peculiar features of these phenomena. Our readers will not fail to remark the general agreement between Prof. von Bezold's observations and those of Dr. Helmann.

The former meteorologist describes the following phenomena as to be observed every morning and evening if clouds do not interfere :—

A luminous segment appears on that side of the heavens where the sun is below the horizon (*i.e.*, in the east in the morning, and in the west at eventide). It is separated from the higher parts of the sky by a peculiar light zone. Above this zone the heavens have a blue or purple colour, and below it are seen yellow, orange, and on the horizon even brownish red tones.

At the opposite side of the heaven appears the dark segment which is simply the ash-coloured shadow of the earth, which, as long as it is merely a few degrees above the horizon, contrasts sharply with that part of the sky still (or already) illuminated by the sun,—the so-called counter-dawn.

There is also a faintly luminous circular disc of considerable diameter (at the time of its greatest intensity), and of a rose- or pale purple-red colour. This the author speaks of as the "purple light." It appears above the luminous segment some time before sunrise or after sunset, in such a manner that the lower part of the disc appears to be concealed behind the luminous segment. The centre of the disc, in the evening twilight, goes down very rapidly, whilst at the same time its radius increases, so that at the last the boundary of the disc coalesces with that of the segment. The impression is as if the purple light was gliding down behind the illuminated segment. The purple light seems to play the part of an image of the sun, much magnified, but indistinct in its outlines. At the time of its greatest intensity the light generally increases very decidedly, so that objects which shortly after sunset were no longer distinguishable are again recognised. This is especially the case

with objects at the side of the horizon opposite the luminous segment. Such objects, which were previously sharply illuminated by the setting sun, and were then shadowed by the dark segment, appear at this time once more bathed in a faint reddish light. The maximum of this second illumination occurs in the Alps when the sun is 4° or 5° below the horizon. The centre of the purple light is at this time about 18° above the horizon, whilst its upper limit may rise to an altitude of 40° to 50°.

As the purple light vanishes behind the luminous segment there appears at the opposite side of the heavens a second dark segment. Soon, also, as the first luminous segment descends, there appears above it a second, not readily distinguishable from it, and if the sky is very clear there is sometimes perceived *a second purple light*, and therewith a repeated increase of light, so that objects on the opposite side of the horizon are illuminated for the third time.

The occurrence of two distinct periods of red (rosy or purple) tones, which was dwelt upon by a number of observers as something characteristic of the twilights of last winter, is therefore a normal phenomenon, though rarely witnessed in such intensity.

The excitement which the recent sunsets produced were especially due to the unusual intensity of this second "purple light," which on some occasions seemed to surpass the first one both in extent and splendour.

III. ON ELECTRICITY AND ITS PRESENT APPLICATIONS.*

By W. Fraser, A.M., M.R.C.S. Eng.

(Concluded from page 409.)

MATTER, as it exists in the ether or chaos, is probably in its simple or atomic, and not in the molecular form, as it for the most part appears in the earth. We know that Electron *alone* does not conduce to the union, but, on the contrary, to the dispersion or repulsion of the

* Read at the Aberdeen Philosophical Society, February 5th, 1884.

particles of matter. Indeed it is quite possible, by means of electricity, to loose the molecular attraction of different kinds of matter for each other, and to reduce them to their elementary form, as was done in the notable case of Sir Humphry Davy's discovery of the metallic bases of the alkalies and their allies. It seems to require the presence of gravitation—that is to say, the attractive force of a large mass of matter—to enable Electron to exert those chemical powers which constitute so important a part of his properties.

Thus, then, the Earth, in its rapid journey through the ethereal ocean of space, like the other innumerable orbs that are circulating there, so acts upon that portion of ether that is sufficiently within the sphere of its gravitating influence (or probably within a distance somewhat beyond the circuit of the atmosphere, or 45 miles) as to admit of chemical—that is to say, molecular—combinations and aggregations of matter being brought into existence in such a condition as to be retained by the attractive power of the planet, and thus added as a permanent and continually augmenting increment to its constitution.

Speculating upon the possibility, or the probability of this hypothesis being true, it may be interesting to make an attempt to calculate the amount of increment that would thus be continually added to the mass of our Earth.

The elements required for such a calculation are—1st, the diameter of the Earth, with its atmosphere, or (say) the range at which its attractive power would counterbalance the dispersive power of electricity; 2nd, the mean distance of the Earth from the Sun; 3rd, the time of the Earth's year, or revolution round the Sun; and 4th, the proportion of matter that is contained in ether,—or, rather, the proportion of matter that can be wrested and precipitated from ether by the chemical and gravitative forces under the influence of which it is brought by the Earth's passage through it.

All these have been pretty exactly agreed upon by astronomers, except the last, although it is not improbable that even it too may be ascertained in time. But if it may be allowable to hazard an estimate of it, no one, I think, would say that, whatever may be the absolute proportion of matter in ether, one grain as the reducible portion of it,—that one grain to the cubic mile, that is to say one grain to the thousand millions of cubic feet, would be too large a proportion to assign, and we will solve the problem upon this assumption.

The mean diameter of the Earth is 7912 miles; height of the atmosphere 45 miles; consequently the diameter of the Earth and its envelope is 8002 miles, and the area of its diametrical section would be—

$$\frac{8004^2}{2} \times 3\text{·}1416 = 50{,}315{,}870 \text{ of miles.}$$

Distance of the Earth and Sun, 92 millions of miles; therefore 184 = the diameter of Earth's yearly circuit round the Sun. This multiplied by 3·1416 gives 578,054,400 as the circumference or length of the annual circuit. This again multiplied by 50,315,878, the area of the Earth's section, gives 29,002,310,043,428,000 as the number of cubic miles in cylinder made by the Earth in its annual course round the Sun. This divided by 1,565,800, the number of grains in a ton, gives 1,857,980,378 as the number of tons annually brought within the attractive power of the Earth, and as the possible annual addition to its mass. Spread over the globe, with its 197,000,000 of square miles, this would yield about 9·43 tons to the square mile. Allowing 6080 feet to the mile, a square mile would consist of 36,966,400 square feet. This divided by 9·43 tons, or 147,862,400 grains, would give 0·31 gr. per square foot as the possible amount of matter depositable on the Earth; or 31 grains, if we suppose a cubic mile of ether to contain 100 grains of matter. At this rate it would require fifty thousand years for the addition of one ton—say a cart-load—per square mile of matter being added to the surface of the Earth.

The greater part of the matter would probably be in the form of water and other fluid substances, which would find their ultimate place of deposit in the ocean, and would not make much recognisable addition to the material of our globe. It is possible, too, that the whole of the ether thus moleculated does not become incorporated with the Earth. A portion of it lying next to the outer boundary of the imagined cylinder may probably, though sufficiently within the power of the Earth's gravitation as to have its atoms brought within chemical attraction, not be sufficiently near it to be drawn to its surface, and it may thus either drift away in some other direction, or remain in equipoise like the Moon, and, also like it, circulate with the Earth round the Sun.

The foregoing reasoning, if applicable to the Earth, must of course also be so to all the other planetary bodies, as well as to the suns or stars of the whole universe, thus

affording a glimpse of the stupendous scale on which the theory of development or evolution in this department may be applied. And, as it is believed by astronomers that the stellar system to which we belong is—independently of its other motions—drifting in some to us unknown direction through space, it follows that new and unexhausted fields of either—"untrodden fields and pastures ever new"—are becoming continually accessible, as the pabulum from which God's universe, or family of worlds, receive their nourishment and growth.

The creation of worlds may thus be understood to be a gradual, continuous, and never-ceasing process; and we can easily believe that among the streams of cosmic dust or stones drifting through space, which must have become concreted or gravitated together from the material atoms of ether, gravitation will still further unite them into larger and larger masses, as, in their motion through space, they come within reach of each other's attraction; and thus it will happen that some large and always enlarging ones will come to assume the rank of planets or planetoids, as we actually find that they *are* now doing in our own solar system. This mode of genesis, too, combined with their rotary motion, will sufficiently account for the almost perfect sphericity of the heavenly bodies.

This long digression—if we can call it a digression—on the subject of cosmogony has mainly arisen, as you may recollect, from the sight of Mr. Crookes's radiometer, and the speculation that so suggestive an instrument is calculated to give rise to.

Having made acquaintance with Electron in two of the forms which he exhibits himself, we may now view him in another and almost as important an aspect, that of heat. Nearly all his operations on matter are attended by a motion or vibration of its atoms resulting in, and in fact constituting, what we call heat. The great Genie himself seems gradually to disappear after putting his subject materials into a state of tremulous motion, which gradually subsides, with results more or less observable. He himself may either go into some new arrangement of the materials, or else vanish into surrounding space, though of course he can never be lost or annihilated.

Heat is undoubtedly the most familiar attitude, and the most useful and indispensable form, in which Electron can be viewed; but the purposes he serves, and the benefits he confers on the world, in this character, are so well known and appreciated that it is unnecessary even to enumerate,

much less to describe them. The analogy, nay the identity, of Electron and heat can be experimentally and otherwise shown in a variety of ways; but there is not time to do more than allude to this interesting department of the correlation and mutual convertibility of physical forces.

Let us for a moment change the metaphor so long kept up, and, by using the magician's power, transform our Genie into a wild steed of the Desert, careering at his own wayward will through the prairie and the forest,—dangerous and difficult to come to close quarters with,—admired for his beauty, power, and speed, yet feared and avoided because so untameable and intractable; but when once a material bridle is imposed upon him his speed is greatly subdued, and he becomes the means of carrying man along with him, and of revealing to him all the beauty, grandeur, and wonders of the world. When still further subdued, harnessed, and accoutred, he not only diffuses happiness and life all around him, but can be made to perform a variety of most useful and admirable work, far surpassing in quality and value that of any other creature within the power of man.

Electricity, Light, and Heat may be said to be a unity in trinity, recondite and mysterious to us, but not altogether incomprehensible,—a type or analogy, may we not say, of that greater and still more incomprehensible mystery, the dogma of the Divine essence, which forms an important part of the Christian creed, and which it may well encourage and justify us in believing, even although its full comprehension may be beyond our imperfect powers.

Whatever may be thought of the marvellous and beneficent powers of this great Genie, as I have attempted to describe them, in reference to the *Cosmos*, there is a department of the work assigned him by his Creator which is to us (I mean to medical men) as important, if not even more interesting and wonderful. I allude to the services he performs in regard to the *Microcosmos*, and in the development and the vital action of all living creatures, bearing, as these of course do, upon the physiological and medical aspects of Anthropology. On some of the mysteries of these subjects it is probable that there will fall in time a share of the light which his scientific cultivation is now throwing on other subjects of human interest and utility. But into this department I shall not attempt at present to enter.

The functions of Electron—lying, as many of them do, in the border-land between spirit and matter, have given occasion of late to a contention regarding the respective claims of superiority due to spirit and matter, in carrying

on the operations of the world. Leaving the religious and higher aspect of the subject, bearing on the soul, untouched and unaffected, it may be argued on this point that the property of the living body implied by the terms irritability and contractility may be said to lie at the root, and to be in truth the main test and indication, of life. It is the first and the last of the vital actions of the living organism, manifested in the embryo long before consciousness begins, and remaining for some time after death in the heart and other parts, even when separated from the body. This property is undeniably due to the presence of the neura, or nervous power, which is developed and transmitted by the combined action of the organic mechanism, and it is through the medium of Electron in this form that the brain-power, the feelings, the senses, and in fact whatever may be said to constitute the life of the animal, are maintained. It in truth may claim to be the *ipse ego* of the individual, rather than the bodily receptacle which is inhabited by it. It is true that the two are inseparable and indispensable to each other, and that they act and react on each other in many ways that are to us inscrutable; but the moment the body loses the power of maintaining and transmitting the necessary supply of its animating spirit their complete separation ensues, and the result is death, dissolution, decomposition, and dispersion of its materials. Was it not an unfortunate boast that Dr. Tyndall made when he said that "we can discern in matter the promise and the potency of all terrestrial life"?—meaning to imply that it is independent of any higher agency than what is inherent in itself. It seems to me, on the contrary, that matter is like clay in the hands of the potter, and that God makes use of some intermediate agent or agents, electricity especially, or by whatever other name it may be called, which is not necessarily nor perhaps universally inherent in matter, to carry on His operations in the world; and it is by this power, in fact, that all things are kept together in their present position and arrangement. Were *it* withdrawn, by the Almighty Creator, the property of cohesion would cease; all things would fall asunder into dust, and would probably be scattered into space like the sand or dust in the Desert.

Yes! the supremacy belongs to spirit, and not to matter. All the admirable and elevating works of art, of poetry, literature, and science; all the inventions and discoveries of man, his heroic achievements, his virtues, his religious and philanthropic enthusiasms; these, and it must be added also all their opposites of a malign description, are the

result of spiritual influences—literally of spiritual influences—residing in and energising his person. And all the infinitely more admirable and beautiful forms, both animate and inanimate, in which the material of the world is moulded are the work of that infinitely greater Spirit who predominates and rules over all.

In His government of the universe God has chosen to endow the great spirit Electron with attributes in some degree similar to some of those belonging to Himself, and He has given him potencies in accordance with these attributes; but behind, and upholding, and above them all, there dominates God's own supreme existence and will. Indeed it is impossible to conceive that matter itself, even though acted upon by all the natural or spiritual influences we know of, could mould and fabricate itself into the infinite and yet normal varieties of forms and substances, both living and inanimate, which we see around us.

On the contrary, the living world of which we form a part presents everywhere a never-ceasing miracle of Almighty power and wisdom, although our bodily eyes cannot see the hand that performs the miracles, and the sublime significance of which we fail to comprehend only from its very familiarity and our own innate selfishness and want of spiritual discernment. Thus says Tennyson:—

> "Flower in the crannied wall,
>   I pluck you out of the crannies!
> Hold you here, root and all, in my hand,
> Little flower; but if I could understand
>   What you are, root and all, and all in all,
>   I should know what God is, and man is."

If he is a fool who has said in his heart that "there is no God," by what other name shall we call those who say or insinuate that Electron is all the God that they can recognise as being required in the world; as if a being, however powerful, whom man can force to obey his commands, as his submissive servant, could at the same time be the Sovereign Lawgiver of the Universe. The idea is heathenish and absurd. It is in kind, though not in degree, as much idolatry, or a breach of the first commandment, as the worship of stocks and stones, or of the sun, moon, and stars, or even of heroes or demigods, or of the classical deities of the ancients. Their reasoning in the matter ought rather to be—"If a servant or minister in the economy of Nature has been endowed and entrusted with such attributes and powers, how infinitely more powerful and highly endowed must be the Creator Himself, the source of all this power!"

In connection with this subject, it is only a few years since there raged a long and vehement controversy on what was called spontaneous generation, one party affirming and the other denying that the forces of Nature alone, more especially Electricity, can originate life and organisation in dead matter. But, after years of laborious and well-directed experiment and investigation, the conclusion acquiesced in by all but a few of the most prejudiced partizans is that not even the minutest monad can be produced, except from a parent or previously existing individual of the same kind. God's method, however, and His ordained laws in the never-ceasing and exuberant creation and evolution—to use the new term—of all living things, are beyond the reach of our penetration, notwithstanding the gradual advances that are apparently being made in this direction by *savants* and theologians. Such are "the *depths* of the riches both of the wisdom and the knowledge of God; how unsearchable are His judgments, and His ways past finding out!"—Rom. xi., 33.

As a fair specimen of the reasoning and drift of those who support the idea of spontaneous generation, I shall quote the words of an article on the "Relation of Darwinism to other Branches of Science," by Mr. Ball, the Astronomer Royal for Ireland, in the November number (p. 83) of "Longman's Magazine":—"At the outset of Darwin's theory," he says, "we encounter a very celebrated difficulty. His theory requires life to begin with, but how did that life originate? I need hardly remind you of the celebrated controversy which has taken place on this subject. It has been contended that life can never be produced except from life, but just as stoutly has the opposite view been maintained. Can it be possible that the wondrous and complex phenomena known as life are purely material? Can a particle of matter, which consists only of a definite number of atoms of definite chemical composition, manifest any of those characters which characterise life?" . . . .

"Unusual, indeed, must be the circumstances which will have brought about such a combination of atoms as to form the first organic being. But great events are always universal. Because we cannot repeatedly make an organised being from inert matter in our test-tubes, are we to say that such an event can never once have occurred with the infinite opportunities of Nature? We have in Nature the most varied conditions of temperature, of pressure, and of chemical composition. Every corner of the earth and of the ocean has been the laboratory in which these experiments

have been carried on. It is not necessary to suppose that such an event as the formation of an organised being shall have occurred often. If in the whole course of millions of years it has once happened, either on the land or in the depths of the ocean, that a group of atoms, few or many, have been so segregated as to have the power of assimilating outside material, and the power of producing other groups more or less similar to themselves, then we have no more demands to make on the 'Theory of Spontaneous Generation.' The more we study the actual nature of matter the less improbable will it seem that organic beings should have so originated."

All this seems to me to be only a *petitio principii*, or begging of the question, which there is absolutely no ground for acceding to. It reminds one of the boast of Archimedes:—"Give me a fixed place to stand upon, and I will move the world." "Concede to me," these reasoners say, "that matter can form and fashion itself into a living being, and I will dispense with your God, and depose him from his throne of supremacy." The premiss, if it does not mean this, at all events tends to lead some of its upholders to this and other conclusions which are opposed to the first principles of religion. Such conclusions, however, would be a mistake, even although the premises were proved to be true, for these would by no means do away with the irresistible and unavoidable recognition of an all-pervading, unceasing, and intelligent energy presiding over and throughout the universe.

As a safeguard against the dangerous and atheistical tendencies referred to, we should, in accordance with the instinctive promptings of our own nature, of all nature, and of reason and revelation, believe in God as the Creator and Governor of the Universe; and in gratitude for all that we owe to Him we ought, in the words of Christ's summation of the moral law, to love Him "with all our heart, and with all our soul, and with all our mind." But if scientists choose to make their abode in the cold shade of Agnosticism, or the still colder, darker, and more inhospitable region of Atheism, the loss and damage will be to themselves and to those who adopt their belief—a belief which, if it became general in any country, would, as has been proved by the past history of the world, destroy the basis on which its moral government is founded, and sooner or later bring degradation, misery, and ruin in its sequence.

Given life and organization, given their inseparable combination with Electron,—*but given by whom?*—and we must

admit that the latter plays a most important part in the use and the functions of the powers and attributes of all living beings. But without these postulates, and the conditions necessary for their existence, Electron would be but a blind and reckless, however powerful and all-pervading, a spirit. In the case of any planet, or say that of our own moon, for instance, which is believed to be so destitute of water that whatever portion of this it may contain is drawn by gravitation, and retained in the interior, so that it cannot appear upon the surface; and the absence of this indispensable element of animal and vegetable life would account for the arid, dismal, and death-like appearance which our pale-faced satellite, without any indication of a change of seasons, exhibits when viewed through the most powerful telescopes. *Which she at present presents*, I say, because if the hypothesis suggested be true it is possible that in the course of ages a sufficiency of water may be moleculated and attracted by the moon's own power of gravitation, to supply her with enough of this vital element to enable her, by the will or fiat of God, and through means of Electron, to become at last adapted for and endowed with such a variety of the tribes of animal and vegetable life as that which now enriches and adorns her suzerain, if not also her parent, the Earth.

The Darwinian doctrine does not necessarily lead to Atheism, and it is after all only a theory, admirable, ingenious, and suggestive in its way, but far from being so reliably and in every point true as to have the right to supersede and stamp out the old and universal beliefs which have hitherto governed mankind.

In conclusion, it may be said that Electricity as a science has now passed its stage of infancy and childhood, and is entering upon that of youth and adolescence. Long the plaything and pet of philosophers and medical men, for whose nursing and education it has hitherto brought them but scanty return, it has now grown into importance in a social, industrial, financial, sanitary, legislative, and legal point of view, and has consequently fallen under the protection of the State, and the control of financiers, lawyers, inventors, mechanicians, and speculators, and is expected by many to prove an *el Dorado* to those who have the skill and the Spirit to take possession of the hidden treasures which Electron, like Aladdin's Genie of the Lamp, has in his keeping. But it is quite possible, if not indeed probable, that if the noble Genie be overdriven and hounded on by a band of mercenary and unscrupulous men, he may, like

Samson, when forced to grind and make sport for the Philistines, bring down their financial structures in ruin on the heads of many of them,—a disaster which indeed has already occurred in several instances.

The form of allegory, or slightly interrupted allegory, in which this paper has been cast is of course not like a scientific, or logical, or deductive treatise. It is, and professes to be, nothing more than a semi-fabulous and romantic account of the matter on which it treats. By a wave of its magic wand it sweeps away doubts and difficulties, and fills up gaps or dangerous and defective places which stand in its way. As Browning says—

> "It brings the invisible into play,
> By letting the visible go to the dogs."

By an instinctive stroke of the imagination it fills in whatever is wanting to render its narrative as life-like, truth-like, and acceptable as possible; and yet it is quite possible that it may convey the elements of truth as really as many a dry and laborious philosophical dissertation. By the quaint and grotesque points of view in which it presents the subject, it tends to bring out new features and aspects of it, which might be overlooked in the ordinary light of scientific treatment.

And there is another point of view in which some might be disposed to regard it favourably. If not in accordance with the most recent views in Theology, it is at least in harmony with the older and orthodox idea of the personality of God. It strikes the same key-note of impersonation, and is in accordance with the style of language employed in the Bible, and with the way in which an old Hebrew prophet might have declaimed "Sed eheu quam magno intervallo" on such a subject. Nor is it out of harmony with the mode of expression still made use of, and still most readily understood, by the great mass of mankind regarding God's operations in the world.

IV. EMERALD-GREEN*: ITS PROPERTIES AND MANUFACTURE.

By Robert Galloway, M.R.I.A.

THE poisonous effects of wall-paper stained with emerald-green (aceto-arsenite of copper) appears to be a very favourite topic in many journals; it is continually reappearing in one form or another in different publications, especially medical ones; there has recently appeared a short reference to it under the title, "The Poisonous Effect of Wall-paper." As some years ago I became practically acquainted with its properties and manufacture, a few observations on these subjects may not be without interest.

In the paragraph referred to, it is stated that the poisonous effect of this pigment cannot be *entirely* due to its mere mechanical detachment from the paper. This writer therefore attributes the poisonous effects to the formation of the hydrogen compound of arsenic, viz., arseniuretted hydrogen (AsH_3); the hydrogen, for the formation of this compound, being generated, the writer thinks probable, "by the joint action of moisture and organic matters, viz., of substances used in fixing to walls papers impregnated with arsenic." In some of our chemical manuals, Dr. Kolbe's "Inorganic Chemistry," for example, it is also stated that arseniuretted hydrogen is formed by the *fermentation* of the starch-paste employed for fastening the paper to the walls. It is perfectly obvious that the fermentation of the starch-paste must cease after a time, and therefore the poisonous effects of the paper must likewise cease if its injurious effects are caused by the fermentation. I do not think that arseniuretted hydrogen could be formed under the *conditions*, for the oxygen compound of arsenic is in a state of combination, and the compound is in a dry solid state and not in solution, and the affinities of the two elements—arsenic and hydrogen—for each other are so exceedingly weak that they cannot be made to unite directly except they are both set free at the same moment in presence of each other. Further, for the formation of this hydrogen compound by the fermentation of the starch, or by the growth of minute fungi, the *entire* compound must be broken up, and therefore the pigment would become discoloured; but aceto-arsenite of copper—

$$[3CuAs_2O_4+Cu(C_2H_3O_2)_2]$$

* This substance is also known by the name Schweinfurt green.

is a very stable compound not readily undergoing decomposition, and is consequently a very permanent colour. It has also been not unfrequently stated that the injurious effects of this pigment are due to the arsenious oxide volatilising from the other constituents of the compound. This volatilisation would likewise cause a breaking up of the entire compound, and would consequently cause a discolouration of the paper; but the volatilisation of this arsenic compound is in every respect most improbable.

The injurious effects, if any, of this pigment must therefore be due to its mechanical detachment from the paper; but has it ever been conclusively proved that persons who inhabit rooms the wall-paper of which is stained with emerald-green suffer from arsenical poisoning? If it does occur, then the effects of what may be termed homœopathic doses of this substance are totally different from the effects which arise from larger doses. During the packing of this substance in its dry state in the factory, clouds of its dust ascend in the air, and during the time I had to do with its manufacture I never heard that any of the factory hands suffered, nor did I suffer, from arsenical poisoning. If there is any abrasion of the skin the dust produces a sore, and also the delicate lining of the nostrils is apt to be affected. It is in this way it acts in large doses; I am therefore very sceptical as to its supposed poisonous effects when wall-paper is stained with it.

Different methods are given in works on Chemistry for the manufacture of this pigment, but as they do not agree in every respect with the method which was followed in English colour factories some years ago, it will be as well, for the full elucidation of the manufacture of this substance, to briefly recite some of these methods before describing the one that was, and probably is still, in use; and I will afterwards describe a method which I invented, and which is practically superior to any other, both in the rapidity with which the colour can be formed, and for producing it at a less cost.

It is stated in "Watts's Dictionary of Chemistry" that it is "prepared on a large scale by mixing arsenious acid with cupric acetate and water. Five parts of verdigris are made up to a thin paste, and added to a boiling solution of 4 parts or rather more of arsenious acid in 50 parts of water. The boiling must be well kept up, otherwise the precipitate assumes a yellow-green colour, from the formation of copper arsenite: in that case acetic acid must be added, and the boiling continued a few minutes longer. The precipitate then

becomes crystalline, and acquires the fine green colour peculiar to the aceto-arsenite." I do not know from personal knowledge, but I have always understood that the copper salt employed in its manufacture in France is the acetate. This would account, in my opinion, for the larger crystalline flakes in which it is obtained in France than can be produced by the English method of manufacturing it. Cupric acetate is never employed, I believe, in England,—the much cheaper copper salt, the sulphate, being always employed.

In "Miller's Chemistry" it is stated it "may be obtained by *boiling* solutions of arsenious anhydride and cupric acetate, and adding to the mixture an equal bulk of *cold* water." Why it should be recommended to add *cold water*, I am at a loss to understand.

In Drs. Roscoe and Schorlemmer's large work on "Chemistry," and in the English edition of "Wagner's Handbook of Chemical Technology," edited by Mr. Crookes, the process as described by Dr. Ehrmann in the "Ann. Pharm.," xii., 92, is given. It is thus stated in Wagner's work: "This pigment is prepared by first separately dissolving equal parts by weight of arsenious acid and neutral acetate of copper in boiling water, and next mixing these solutions while boiling. There is immediately formed a flocculent olive-green coloured precipitate of arsenite of copper, while the supernatant liquid contains free acetic acid. After a while the precipitate becomes gradually crystalline, at the same time forming a beautiful green pigment, which is separated from the liquid by filtration, and after washing and carefully drying is ready for use. The mode of preparing this pigment on a large scale was originally devised by M. Braconnot, as follows:—15 kilos. of sulphate of copper are dissolved in the smallest quantity of boiling water, and mixed with a boiling and concentrated solution of arsenite of soda or potassa, so prepared as to contain 20 kilos. of arsenious acid. There is immediately formed a dirty greenish coloured precipitate which is converted into Schweinfurt green by the addition of some 15 litres of concentrated wood-vinegar. This having been done, the precipitate is immediately filtered off and washed."

As I have already stated, the copper salt used in the manufacture of this pigment in England is the sulphate, and it is carried out pretty much according to Braconnot's method as described by Dr. Ehrmann; but anyone would infer, from reading his description of the manufacturing process, that the compound, aceto-arsenite of copper, was formed almost immediately after the addition of the acetic acid, a

higher or lower atmospheric temperature having no effect in hastening or retarding the formation. Furthermore, it is not stated whether the compound forms more readily in an acid or neutral solution, or whether it can or cannot be formed in a neutral one; now both these points are important to notice in describing its manufacture. As regards the former I shall notice it presently, and, as far as my knowledge extends, the pigment will not form when the solution is neutral.

The operation is conducted in the following manner in the factory:—The requisite quantity of sulphate of copper is placed in a large wooden vat, and hot water added to dissolve it; the requisite quantity of arsenic (arsenious anhydride) and carbonate of soda, the latter not in quantity quite sufficient to neutralise the whole of the sulphuric acid set free from the sulphate of copper on the precipitation of the copper as arsenite, are placed in another wooden vessel: water is then added, and the formation of the arsenite of soda and its solution are aided by the introduction of steam into the liquid. When complete solution has been effected the arsenic solution is run off into the vat containing the solution of the sulphate of copper, arsenite of copper being at once precipitated. The necessary quantity of acetic acid is afterwards added. In *warm* weather the formation of the aceto-arsenite soon commences after the addition of the vinegar; but, even in that case, it takes a week or more to have the whole of a big batch of arsenite converted into the aceto-arsenite; and perfect conversion is necessary, as the presence of a very minute quantity of unchanged arsenite lowers very much the price of the emerald pigment, and a by no means large quantity renders the pigment unsaleable, owing to its dirty yellowish green colour. In cold weather a much longer time is required for its complete conversion; even at the end of a fortnight or three weeks there frequently remains sufficient unconverted arsenite to affect seriously the selling price of the colour: when this occurs the manufacturer generally removes these last traces by a most wasteful method, *viz.*, by adding a quantity of free sulphuric acid. The acid of course dissolves the arsenite, but it dissolves in very much larger quantities the aceto-arsenite; and this costly solution is not utilised, but is run into the factory sewer.

By my method of manufacturing it, it can be produced in winter as well as in summer in one or two hours, and the quantity of free acid required for its formation is reduced to the lowest amount. I proceed as follows:—After having

dissolved in hot water the requisite quantity of cupric sulphate, I decompose one-fourth of this salt by adding just sufficient of a solution of carbonate of soda to precipitate the copper, in that quantity of the sulphate, as carbonate. I then add just sufficient acetic acid to convert the carbonate into acetate. I have now got in solution—

$$3CuSO_4 + Cu(C_2H_3O_2)_2,$$

and I have to transform it into—

$$3CuAs_2O_4 + Cu(C_2H_3O_2)_2.$$

It is at once seen that I have got the requisite quantity of acetate formed. I next dissolve the requisite quantity of arsenious anhydride in an amount of carbonate of soda *rather less* than is sufficient to neutralise the acid in the remaining cupric sulphate, and I then bring the solution to or near the boiling-point by introducing steam into it: the arsenic is dissolved not in the same vessel as the copper salt, but in a separate one. When the arsenic solution is fully heated a small current of it is allowed to flow into the vat containing the copper salts, and brisk stirring is kept up in the vat. The emerald-green is at once formed; but if there should be the slightest formation of any arsenite, the flow of the arsenic solution is at once stopped until every trace of the arsenite has been converted: the arsenic solution is then allowed to flow in again, with the same precautions as before: in this way a large batch of emerald-green can be formed in one or two hours, without containing the slightest trace of the arsenite. I keep the arsenic solution near the boiling-point during the whole of the time it is flowing into the other vessel. By varying the proportions of water I could either make it coarse or fine, as I wished, which is an important matter to have complete control over in its manufacture.

Two points of interest occurred to me during the time I was occupied with the research, which I had not time to complete: one was whether the aceto-arsenite can be formed, adopting the old method for its formation, if there is more than a certain quantity of water; from some experiments I made in this direction I was inclined to the opinion it could not. I have already stated that emerald-green is soluble to a certain extent in acids, and that it is formed in a more or less acid solution; consequently a varying amount of the pigment is always lost by being dissolved in the supernatant

liquid. To prevent to a certain extent this loss I precipitated the copper from it as arsenite; but I was not successful in the few experiments I had time to make on this part of the subject of re-converting the copper arsenite thus obtained into the aceto-arsenite by the addition of acetic acid.

V. SIGNIFICANT NOMENCLATURE.

By WM. JOHN GREY, F.C.S.

MR. F. FERNSEED, as a representative of the non-significant side of scientific nomenclature, has made a very able attack upon the opposite school in the "Journal of Science" for April last, and I wish, as one of those who are of opinion that a scientific name should be made as significant as is conveniently practicable, to offer a few observations by way of reply. Significant names are systematic names, and therefore scientific names, for the object of Science is to systematise knowledge as well as to acquire it; indeed the mere accumulation of facts is scarcely to be dignified with the title Science.

Sciences have advanced rapidly or slowly, very much in proportion to the amount of system which could be applied to them. As examples of this, the cases of Astronomy and Meteorology may be cited: in the first great progress has been made, mainly on account of the system which the law of gravitation enabled to be constructed out of the observed facts; in the second case we have but little more than a chaos of observations which it has not yet been found possible to systematise.

The science of Chemistry occupies a kind of mean position between the perfect system in Astronomy and the almost complete lack of system in Meteorology. Much has been done in the way of systematising Chemistry, but probably very much more remains to be accomplished, and chemists are yet waiting for the man who will do for their science what Newton did for Astronomy and Darwin for Natural History. No significant nomenclature is possible unless the science in which it is used has become more or less systematised, and hence significant names are an indication of at least some progress. It is of course easy to object to

significant names on account of their length, and an objection on this ground applies especially to the names used in Organic Chemistry, many of which are certainly somewhat cumbersome. Dinitromonobromobenzene is a long word, and it is not very pretty or euphonious, but it clearly indicates what the compound is (isomers excepted); and the gain of such clear indication is enormous. The great beauty and utility of these long names in Organic Chemistry is that they distinctly state to a chemist, who may never have heard of the compound, exactly what it is. There may or may not be such a substance existing as amylethylmethylphenylammonium hydroxide: I never read of it, but if I met with the above name I would have no difficulty in writing the formula, and I would also have a general idea as to its properties and probable reactions. It is possible to make fun of monstrosities like the above, and occasionally a feeble jokelet appears in the comic papers based on the long names in Organic Chemistry; but scientific nomenclature is meant for scientific men, who need not care if outsiders try to veil their ignorance by endeavouring to raise a laugh. One objection to significant names in this science is that a compound not unfrequently has two or even more names, according to the view taken of it. Thus C_6H_5Cl may either be looked upon as a chloride of the positive radical phenyl, or as a substituted derivative of benzene; in the one case it is termed phenyl chloride, in the other monochlorbenzene. Similarly the compound $C_6H_5NH_2$ may be called phenylamine or amidobenzene, according as it is regarded as derived from ammonia by replacing an atom of hydrogen by phenyl, or from benzene by replacing a hydrogen atom by amidogen. These double names do not cause any real inconvenience to chemists, but they doubtless perplex learners.

Occasionally theories change,—that is, the method of classification alters,—and this necessitates some variation in significant names: this variation causes, or at any rate tends to cause, confusion, and its existence—or at least the liability to its existence—is rightly put forward by Mr. Fernseed as an argument against significant names. There is certainly some force in this contention, but it scarcely outweighs the general utility of significant names, and the instance quoted as to a change in a significant name rendered necessary by a change in theory is not very apropos. The compound $Na_2S_2O_3$ had been in the first instance assigned an erroneous appellation. Sodium sulphite is

$SONao_2$, and the prefix "hypo" to the name of an acid indicates that the acid with the prefix contains less oxygen than the normal acid. In the case before us, however, the prefix was erroneously used to denote not a compound containing less oxygen, but one having an extra atom of sulphur. The salt $Na_2S_2O_3$ was thus incorrectly named at starting; and when Schützenberger discovered the compound $SNao_2$, which was the real hyposulphite, a difficulty certainly arose, —not in consequence of a change in theory necessitating a change in a significant name, but because an incorrect name had been assigned to $Na_2S_2O_3$, by Chaussier, at the outset. Clearly sulphosulphate or thiosulphate is the correct name, and had the salt been thus designated at first there would not have been any difficulty caused by the discovery of the real hyposulphite.

I am not prepared to assert that no cases have arisen of a change in theory causing confusion in nomenclature, by rendering imperative the alteration of a significant name, but certainly the instance mentioned is not such a case.

The utility of significant names is obvious, and it would be a great convenience (to take Mr. Fernseed's illustration) if instead of calling a man John Smith it were possible to name him in such a manner as to indicate his mental, moral, and physical capacity and bias. We would then, on being introduced to any one, know how far his acquaintance was desirable. It is not possible at present to name persons in this manner, and so, when introduced to Mr. John Smith, we have to find out such of the above-mentioned particulars as we desire to know in the best way we can. This would never do in Science; it would be fatal to further progress if there were a few hundred "John Smiths" in Organic Chemistry, and we were compelled to find out by research of which one we had got hold. Thus, then, I contend that in ordinary life significant names would be very useful, and that the fact that we manage to do without them is no argument against their use when such use is possible.

Supposing that each chemist who invents a new compound (and there are scores of men who invent scores a-piece) were to name it anyhow, the confusion would put an end to all further research. A chemist works, for example, at the substitution derivatives of a hydrocarbon; there may be scores of such derivatives, including isomers; and what would be the result were he to give them "fancy" names? We might get several hundred organic compounds called "Cinderalla," for instance.

At present significant names in Organic Chemistry, long

and awkward as many of them are, so far from being a "crying evil," are absolutely essential to progress. An alternative may possibly be found in a scheme of classification similar to that outlined in Prof. Frankland's "Lecture Notes." Organic compounds are divided into thirteen classes, and the classes are divided into series, the members of a series differing from each other by the increment CH_2. For example, butyric acid is the fourth member of the first series of Class 7, and might be designated as C. VII., S. 1, No. 4. There would, however, have to be much sub-classification to include the majority of chemical compounds, and some method would have to be devised for indicating substitution derivatives and the host of isomers resulting therefrom. Still a system similar to the above seems at present the only alternative to significant names of terrible length. Probably, however, some day the science of Chemistry will bend her fair neck to the yoke of Mathematics, and then the symbols of Algebra and of the Calculus will replace "significant names."

VI. THOUGHTS ON IMITATION.

By J. W. Slater.

"MIMETISM" or mimicry,—the truth which Bates and Belt discovered in their tropical wanderings, and which other writers have since been hammering out into the very thinnest of gold leaf for the edification of their readers? No: I wish to say a few words on intentional, conscious imitation by one animal of the gestures, movements, and sounds of other creatures. It is, perhaps, strange that a phenomenon of so daily occurrence should still be misunderstood, but here, as elsewhere, familiarity breeds contempt. In short, "imitation" is a word with which men juggle almost as cleverly as they do with "instinct." A monkey is seen to unlock a door, or to put on a pair of spectacles; a parrot, seeing someone in company take out his handkerchief, enquires "Have you got a cold?"

Immediately *Homo sapiens* dismisses the whole matter with a curt, "Ah, only imitation." Here *Homo sapiens* doubtless forgets that his own vaunted faculty of speech—according to Professor Max Müller and others the Rubicon between man and "brute"—is merely, as we shall find below, an outcome of this same propensity.

But do we ever ask ourselves what the power of imitation involves? Let us take the common case of a parrot imitating human speech: what faculties must the bird possess and exercise before such imitation is possible? In the first place there must be close and accurate observation. The bird must distinguish with great nicety the sounds which she hears, including, not merely the effect of the different letters, but all the peculiarities of the speaker's voice, as loud or soft, high or low, gruff or smooth, with all the minutiæ of accent and pronunciation in which one speaker differs from another. So close is the reproduction that a parrot brought up in "society" may be at once distinguished from its fellow which has received a tavern education, even when uttering the very same words.

I need scarcely say that we have here full proof, not alone of close and accurate observation, but of attention. The bird evidently concentrates its mind upon the sounds heard.

Another faculty which "mere imitation" implies is memory. A parrot or magpie, or other talking bird, when it has once mastered a word or phrase, will retain it for years. We must even admit in these birds, as in ourselves, the existence of *latent memory*. A parrot may cease to utter some speech, and judging from analogy may have forgotten it. Suddenly, without any outward cause, or at least without again hearing the words, they return to her mind, and are again uttered. Of this I have had a very decisive instance: My parrot, a fresh arrival from the Gold Coast, and only beginning her education, heard some words uttered in the Norsk language by a little grandson of mine who was over on a visit from Norway. She caught up the words, repeated them for a few days, and then apparently forgot them. Suddenly, some fourteen months afterwards, she surprised me by bringing out the very same Norsk words, which she had certainly never heard in the meantime.

But verbal imitation implies something much more than verbal memory. The words uttered are connected with objects and events seen or taking place at the time when the words were first heard. This is proved by the familiar fact that parrots, magpies, ravens, &c., learn to connect names

with persons, things, and actions. It is nothing unusual for such birds to call the members of the family correctly by name, to exclaim "good morning" when anyone first enters the room in the morning, to call out "good-bye" if anyone is leaving. My parrot above mentioned has more than once on seeing water drawn from a tap, cried out: "Water, water! Polly wants!" Another, belonging to a late medical friend of mine, if she saw any kind of food being consumed, especially fruit, always said: "Give Polly a bit if you please!" Another parrot, an ill-tempered, noisy bird, the property of an extensive taxidermist, when she has been screeching, generally finishes by saying: "You devil, what is this row for?" Thus we have full proof that "mere imitation" implies not only a recollection of words, *per se*, but their remembrance in connection with all the attendant circumstances. So that henceforth the sight of a person or object, or the occurrence of an action suggests to a parrot the words. Here, therefore, in addition to memory there is association. It need scarcely be said that all the powers of observing, retaining, and associating sounds possessed by parrots and certain other birds would go for nothing if they had not in addition well developed vocal organs, and if, further, their nerve centres were not highly specialised.

The higher birds thus learn the use of language in the same manner, though not to the same degree, as do we in our childhood.

It is remarkable how completely metaphysicians and philologians forget the imitative origin of language in man. Some of them incline to the opinion that language is not a faculty which has been gradually developed, but a divinely implanted power. Such thinkers might do well to consider that children who have been brought up by wild animals, *e.g.*, among Pariah dogs in India, are mute; that not only those who have the misfortune to be born deaf are also, but that children who have at different ages become deaf from disease lose the power of speech. Hartmann, in his work "Deaf-Mutism," gives, if I remember aright, an instance of this occurring even as late as the tenth year of life. Hence language in man, as in the parrot, is simply due to imitation, and where such imitation is excluded by deafness, or by the absence of human society, he, too, is, according to a common cant phrase, one of the "dumb animals," How the anti-evolutionists can justify their theory of the origin of speech in the face of these facts I do not see.

The imitation of the actions and gestures of man, or of

other creatures, is more common among mammals than birds, from structural reasons. To what an extent it occurs among the monkey tribe is well known. In the cats, or at least in the one species of that group which ordinarily comes under human observation, it is not unknown, though rare. The same may be said as regards dogs and weasels. But lower down in the mammalian series it appears unknown. We find no instances of imitation among the marsupials, the edentates, and probably the ruminants. We must, however, among the latter exclude that crude phase of imitation which is witnessed in sheep, where, if one runs, all the rest run, and if one jumps, all jump, even though the object to be overleapt has been removed. But we never see a sheep attempting to imitate the conduct of a man, a dog, or a cat. The ruminants are not wanting in curiosity, which in weak species is largely mixed with fear and suspicion, and in stronger ones with hostility. But it is in all cases undiscriminating.

The imitative actions of mammalia of course imply, other things being equal, the same faculties as the imitative sounds or cries of birds. We may therefore regard it as, to say the least, discreditable rashness, when metaphysicans and *litterateurs* pronounce such actions of birds and mammals "merely imitative" in the hope of thereby denying the intelligence thus manifested. For, in addition and prior to the desire to imitate, there must exist, as we have seen, certain intellectual faculties, without which that impulse, even if it existed, must be abortive.

But wherefore should any animal seek to imitate the actions of another animal whether of its own or a different species? What advantage can it derive from such imitation? At first sight it might seem none whatever, and we might perhaps feel puzzled how to account for the origin of the propensity for imitation, whether we regard it as an impulse originally implanted in certain species, or as having been developed under the action of the struggle for existence.

But we should in so doing fall into a grave error. It has been found that the tiger imitates the peculiar whistling cry with which the large Sambur deer call one another. The imitation is said to be so close that only an experienced ear can distinguish any difference. The leopard of India, in like manner, counterfeits the cry of a smaller species of deer. Here we may carry our considerations of what is involved in imitation at least one step further. The tiger has not only observed closely and accurately the cry of the deer,—not

only fixed the particulars in his memory and associated the sound with meeting of deer after it has been uttered,—he, in addition, sees that there is here a certain advantage to be derived, and accordingly reproduces the whistle with great fidelity. Further observation will doubtless disclose many more instances of purposive imitation in the conduct of animals, as distinguished from involuntary mimetism. But most of the animals which possess the tendency to imitation in a high degree, such as the monkeys and parrots, are not carnivorous, and therefore cannot have any such motive as the tiger or the leopard above mentioned.

We must therefore inquire what properties the imitative animals have in common? They are all, probably, decidedly sociable; all occupy an eminent rank in their respective groups, and all, from man downwards, have a highly developed brain and nervous system. They all require a language as a means of communicating to each other their wants, their fears, and, to a certain extent, their ideas. But were they not imitative they evidently could never have possessed languages. The sounds made by each would not have been repeated by others, and would thus never have become the common inheritance of the species.

But there is a further consideration: the higher the development of any animal, species, or individual, the less exclusively are its actions to be understood on utilitarian principles. If we analyse the activity of man, keeping our eye especially on the highest races, and the highest members of such races, we find that no small proportion of such activity is directed to objects which have no direct connection with the preservation either of the individual or of the species. The savage, when not ministering to the direct wants, nutritive or sexual, of the passing moment, does very little indeed. The savant and the artist seek to minimise the share of their energies employed in self-preservation. Viewing this wide range within the boundaries of one species, commonly so called, is it too much to suspect that, even in certain of the lower animals, a portion of vital energy and of time may be consumed in pursuits which might be dispensed with? The caged parrot, indeed, utilises the human language which it learns by calling attention to its wants. But, as far as I can judge, it derives pleasure from imitating the cries of cats, dogs, poultry, the sounds of musical instruments, and the creaking of machinery. In like manner the monkey feels

satisfaction in attempting any performance which it has not yet seen. Both these animals, to me at least, seem to have a reserve fund not merely of energy, but of intelligence, which, as in the case of the savage, is not ordinarily called upon in the normal business of their lives. How this intelligence can have been developed is to me a riddle, alike in the savage and in the ape.

It has been often remarked that, in man, gestures, actions, feelings, conduct of the most varied kind, is, in vulgar language, *catching;* that hysteria will spread through an establishment for young ladies or a nunnery as rapidly as can scarlet fever. May we not suppose that the tendency of monkeys and parrots to imitate the actions and sounds which they see and hear is a part of kindred origin?

VII. OBSERVATIONS OF BRIGHT LINES IN THE SPECTRA OF FIXED STARS.

THE spectra of certain fixed stars have been made the subject of careful and frequent observations, and the results obtained have led astronomers and physicists to some interesting conclusions. They have inferred, for instance, a general identity of the elementary chemical composition of the universe, or at least of all of the stars which they have been able to examine. They have also classified the stars according to their apparent age. First, namely, come those which give out a bluish white light, and are therefore still in the most intense state of ignition. Secondly, those which, like our Sun, give out a more yellowish white light, and which have probably lost some of their original heat. Lastly comes a class whose light is reddish, and which may therefore be supposed, by analogy with terrestrial fires, to have cooled down considerably.

But later observations, especially those of H. Eugen von Gothard and H. von Konkolly, as described in the "Astronomische Nachrichten" and in the "Naturforscher," point to frequent changes in the physical condition of certain

stars, not obeying, apparently, any regular period, nor depending on a mere increase or decrease of temperature.

An unusual appearance of bright lines in the spectrum of γ Cassiopeiæ and β Lyræ seems first to have been noticed by the late Roman astronomer Secchi. Subsequently Mr. Huggins identified in γ Cassiopeiæ the bright lines H_α, H_β, and D_3, whilst in 1872 Herr Vogel could see and measure only the bright line H_β. He further suspected a bright line in the yellow (D_3), and found only a few dark lines in the red. In the spectrum of β Lyræ the same physicist measured, in 1871, three bright lines identical with H_α, H_β, and D_3. Subsequently these lines became so faint that they could be perceived only by the aid of especial artifices. Even in different successive evenings they appeared of different intensities, which could not be brought in connection with the conditions of the atmosphere.

Subsequently these bright lines seem to have disappeared entirely, for though they were repeatedly sought for at the Observatory of O'Gyalla they were not seen from 1874 until 1882. Herr Eugen von Gothard frequently examined these interesting stars spectroscopically since the opening of his Observatory, in the autumn of 1881, but without effect. In 1882, on July 24th and August 7th, he could distinguish in γ Cassiopeiæ merely a dark band in the red. The spectrum of β Lyræ was about this time continuous without lines or bands. On September 5th, however, the dark lines H_α, H_β, and H_γ were observed.

The two stars in question seemed, according to these phenomena, to belong to the class of temporary stars which blaze up with great intensity and then fade down to a greater or lesser extent. But further observations did not support this supposition. On August 13th, 1883, Herr von Gothard saw in the spectrum of γ Cassiopeiæ the red line H_α flashing up along with the dark lines formerly observed; but on account of the bad state of the atmosphere and of moonlight nothing could be determined with certainty. But on August 20th not only the line H_α, but the lines H_β and D_3 were distinctly recognised: the bright lines could even be measured, and gave the wave-lengths for H_α 654·7, for D_3 586·7, and for H_β 484·9, whilst for the middle of the dark band λ was found $= 633·0$. These lines were observed also August 22nd, 24th, 25th, and 26th. H_α and H_β came out well, D_3 not so well and less frequently. On August 26th Herr von Konkolly, who took part in the observations, succeeded in recognising the violet line H_γ.

On September 1st the lines H_α and H_β were very intense in spite of the moist and disturbed state of the atmosphere; H_γ was also distinguished. D_3 was no longer visible, but the dark sodium lines were seen. The latter, however, could not be measured, and subsequently they disappeared entirely like D_3. The lines H_α and H_β were observed at the end of September and in November, even in the most unfavourable circumstances. H_γ appeared also several times when the air was better, as well as the dark lines of the *b* group.

The measurements which Herr von Gothard succeeded in executing on November 29th showed a displacement of the bright lines towards the red extremity of the spectrum. The determinations were therefore repeated on December 21st, with a very careful comparison with a Geissler tube filled with hydrogen. The comparisons were limited to the line H_β, and gave for the wave-length of the line in the spectrum of γ Cassiopeiæ the value 486·5, and in that of the Geissler tube the value 485·9; consequently a displacement of 0·6 millionth of a millimetre towards the red end of the spectrum.

In the spectrum of β Lyræ, also, the bright lines which had vanished up to 1882 reappeared in August last year (1883). The lines H_α and H_β were very distinct on August 26th, but they could not be distinguisned on September 28th, possibly on account of the great perturbation of the air. The next evening (September 29th) Herr von Gothard was surprised on witnessing the following phenomena:—D_3 was brilliantly beautiful, the most intense of the three lines; H_β was very fine; but H_α was very faint, scarcely visible. Occasionally a dark band was perceptible, rather more strongly refractive than H_α. In proportion to the general faintness of the spectrum, the bright lines were much more intense than in γ Cassiopeiæ.

On October 18th the bright lines D_3 and H_β and the dark band were very distinct, notwithstanding the badness of the weather and the strong moonlight. This was the more remarkable as in the previous year the search for these lines had been unsuccessful, even in the most favourable weather. On October 26th, with a large new spectroscope, the bright lines D_3 and H_β and the dark sodium lines were still very distinct.

On November 21st occurred another unexpected change. Herr von Gothard could find only the bright line H_β, and this with great difficulty; D_3 and H_α were vanished. On

November 23rd D_3 and H_α were again visible, though faintly, whilst H_β was tolerably distinct.

On November 28th, though the atmosphere was very much perturbed and the constellation low in the heavens, H_β and H_α were easily perceived, and even H_γ was often suspected, whilst, in spite of all attempts, D_3 remained invisible.

It need scarcely be said that the key to these anomalies can be found only by a multiplication of observations in the most favourable localities.

ANALYSES OF BOOKS.

The Law of Sex: being an Exposition of the Natural Law by which the Sex of Offspring is controlled in Man and the Lower Animals, and giving the Solution of various Social Problems, with Forty Illustrative Portraits. By G. B. STARKWEATHER, F.R.G.S. London: J. and A. Churchill.

THE author of this work propounds a law, which if capable satisfactory demonstration is of very great biological value. Not confining himself to pure science, he has also an eye to practical applications, and believes that among the results brought about by the publication of his work will be "the possible assimilation of alien and lower races, and the avoidance of a lamentable redundancy of women in old settled countries."

In forming an estimate of the work—or rather of the theory which it expounds—we have to deal with the double question: Is the proposed law valid? and, admitting such validity, will its practical recognition lead to the results which Mr. Starkweather hopes?

The primary problem is this: Given a pregnant female animal, what will be the sex of her offspring?

Before stating his own reply the author reviews certain existing opinions. Thus we are told by some that the parent which at the moment of conception is the more impassioned impresses its sex on the offspring. The older theories of sex, are rightly enough, described as "chiefly ovularian or spermatic, with various theories of development superadded, such as those of epigenesis, metamorphosis, and syngenesis." A vague popular notion is that the will or the imagination of the mother determines sex. Dr. Naphreys puts forward a hypothesis which has a more scientific appearance. He maintains that every ovum passes through two distinct phases of development. If it is fecundated during the former stage the offspring will be female, but if during the latter male. This view, however, is not supported by recent observations. The author further asks, acutely enough, "How would this theory apply to twins, or to multiparous animals where there may be representatives of each sex produced at a birth?" We must here, however, quote a passage as indicative of his habits of thought:—"Would it not be positive confusion if Nature has, as Dr. Hough maintains, given but six days per month in which females can be conceived —and if in the last two or three of these they must be insufferable viragoes; and to the males has allotted as many more days—on

the first three of which shall be produced specimens as much too effeminate as the preceding ones were too masculine? Is it possible that Nature is thus constrained to inflict misery upon so large a portion of the human family?" Alas! if the avoidance of misery were a ruling principle in Nature, should we see sickly or debilitated animals still capable of reproduction, and thus perpetuating disease and suffering? We quote the above passage, however, as an instance of the author's tendency to argue from moral considerations when discussing physical laws.

Another theory, the so-called "Alternate," is that Nature makes all human *ova* either male or female, and supplies the former one month and the latter the next. This supposition is again refuted by the case of twins of different sexes.

The theory commonly ascribed to Hippocrates is that the parent physically the more vigorous at the time of conception gives his or her sex to the offspring. As Cuvier words it:—"To obtain an excess of female offspring the father should be young and ill-fed, and the mother should be of mature years and highly fed." Certain experiments performed with flocks of sheep seemed to support this hypothesis. But it was found that eighteen consumptive mothers (who by-the-bye should not have been married at all) gave birth to eighty-seven children. Upon the basis of vigour most of these should certainly be boys. But no; seventy-four were girls and only thirteen boys—one seventh.

Before proceeding to expound his own theory Mr. Starkweather discusses the comparative rank of the sexes. To his conclusion that both are essentially equal, though not identical, we cannot object. But what must we think when, speaking of those who maintain female superiority, he writes, without comment,—"The general tenour of their arguments is that woman is a later creation (!) and therefore of a higher order"? Another chapter, on "Heredity and Sterility," contains, along with much that is suggestive and worth a careful consideration, the following passage, strangely out of place in a scientific treatise:—"It might make mothers blush if they knew how many a tale is written so plainly on the faces of their children that the whole world may read what they had fondly hoped would ever remain a profound secret. Where you find a family of children strongly resembling their father, it is unmistakable evidence that he was almost constantly in the mother's mind during the period of gestation."

These preliminary matters being disposed of, we come to the author's law, to wit:—"*That sex is determined by what I shall designate as the superior parent; also that the superior parent produces the opposite sex.*" Of course we naturally ask in what sense is the term "superior" here used, and how is superiority to be recognised? The answer is by no means so clear to the reader as it doubtless may seem to Mr. Starkweather himself. He admits that there are numerous factors to be taken into account, such as temperament, activity, energy, will, intellect,

features, colour, physique, health, nutrition, &c. The term superiority "must be understood to include all these . . . . and it does not follow that this kind of superiority must in all cases coincide with superiority in the general sense of the term—by which we imply superior mental and moral qualities." We have, then, the difficult task of comparing two values, M and F, each made up of ten or more variables, for most of which we have no definite standard. Hence, in bringing Mr. Starkweather's theory to the test of observation, there is room for doubt and even misinterpretation. This we much regret, since it stands in the way of that full examination and fair decision to which it is entitled.

It may, however, be suggested, that the author has refuted himself. If we understand him aright he considers that the sex of the offspring must depend on the relative state of the parents at the moment of conception. He urges that "the theory advocated in this work is applicable to the lower organisms equally with man. . . . . If it could not be thus applied it would be worthless as a complete theory." Yet on page 26 we find him writing—"It has recently been discovered, by repeated experiments, that the sex of butterflies depends upon the surrounding conditions of the larva rather than upon the anatomical structure, as has heretofore been universally supposed. The sex of almost everything else in nature is determined at the time of conception, or *very early in the embryonic state*; and why should these creatures form an exception to the rule? Caterpillars that were fed abundantly for a time before entering the chrysalis state came out female butterflies in the proportion of ten to one, while those which were deprived of food altogether came out with a like predominance of the male sex. M. Gentry confirmed this fact in his experiments with moths." Here, therefore, Mr. Starkweather's view is plainly inapplicable, and, according to his own admission, is hence "worthless as a complete theory"! We should feel disposed to suggest that the author would, for the present, do well to confine himself to the vertebrates.

The attempt to ascertain what "life is like" by a comparison with electricity opens up regions of speculation far too wide for present discussion, even if the state of human knowledge would admit of their useful consideration. The author, speaking of the generative act, says:—"Like other electrical phenomena it is practically *instantaneous*: is this nothing more than a coincidence? Have not these forces a common origin?" It is surely unsafe, on such a slender basis, to identify life, or one of its manifestations, with electricity.

A strange contention is here borrowed from a Dr. J. C. Jackson, of New York, that—"It lies within the power of the individual to modify his physical organisation so that it may be very different from what it has been. . . . . What can thus happen in physical conditions can to an equal extent happen in mental conditions. The dull man can become bright, the excitable man

cool, &c." It may be asked how this agrees with the full admission of the predominant importance of heredity, of the supremacy of nature over nurture, which we find in the beginning of Chapter V.? The author there justly asks whether it was education "that made the contrast between Newton and Boswell? or Henry Kirke White and Edgar Allan Poe?" And if training in youth, when the system is still mobile, is of less importance than blood, can we be seriously asked to believe that the adult man or woman can revolutionise his or her constitution or character?

But supposing that we accept the author's theory as regards man and the vertebrates generally, are the practical applications which he thinks it admits of as important as he supposes? He, in common with Mr. Greg, speaks of the "lamentable excess of women." But this is due not to physiological or moral causes, but to economical conditions. An immense number of men, in this age of mad competition, are shut out from marriage by the simple impossibility of maintaining a wife and family. What is needed is that the supply, both of men and women, should be within the demand, and this can be done only by confining the perpetuation of the species—as in the case of the domestic animals—to the *élite*. The redundancy of women has been greatly fostered by those social *bacilli*—if we may use the expression—who are striving to sow enmity between the two sexes, and to "undifferentiate" our species by setting women to do men's work. For every woman who edges herself into a profession it is safe to say that at least one other woman is doomed to join the "redundant" class whose existence is lamented. We are, therefore, glad to find that a needed rebuke is here administered to a lady who has made herself prominent both in promoting antagonism between man and woman and in throwing obstacles in the path of biological research.

Taken as a whole the work literally teems with interesting matter, and there are numbers of passages which would be well worthy of attentive discussion did space allow.

Sleep-Walking and Hypnotism. By D. HACK TUKE, M.D., LL.D. London: J. and A. Churchill.

THE subject of sleep-walking is not unnaturally attracting no small share of attention. Connected as it is with epilepsy, with insanity, and with what is known sometimes as Mesmerism and sometimes as Hypnotism, its study may aid in solving certain of the most interesting problems, both physiological and psychological. We are therefore glad to find that so competent an

authority as Dr. Tuke has undertaken to consider sleep-walking or somnambulism as parallel with hypnotism. He remarks, in the very outset of his treatise, that "on the vexed question of animal magnetism the bearing of natural somnambulism is most important, as the condition and acts of the sleep-walker cannot be attributed to a magnetic fluid passing from an operator to the subject.

It need scarcely be said that Dr. Tuke does not, with Casper, refer the majority of cases of sleep-walking to credulity or imposture. He admits, of course, that it may be simulated, without on that account denying genuine phenomena. Its connection with chorea, with hysteria, epilepsy, and even insanity, is recognised, though the author does not feel free to remark, with Dr. Echeverria, that "somnambulism generally forebodes, when it does not betray, insanity." As a matter of course, in all the above-mentioned phenomena, normal will is for the time being lost. But it is difficult, if at all possible, to give an account of what takes place in sleep-walking without using language applicable to mental aberration. From instances here mentioned it is plain that the sleep-walker may be no less dangerous to himself and others than the lunatic. Not to speak of the frequent attempts of sleep-walkers to rush out at the windows of upper rooms, &c., a case is mentioned of a man named Fraser who killed his child whilst in a fit of somnambulism, and on trial was found not insane, but irresponsible. The author holds that this man, if not insane, was as dangerous as a madman, and thinks that "more stringent means ought to have been taken to guard against his doing anyone an injury,"—an opinion in which most of his readers will coincide.

Some decidedly conflicting views are given on the responsibility of sleep-walkers. Thus Foderé holds that a man who commits a bad action during sleep is not wholly inexcusable, since in accordance with most observations he is only executing the plans which occupied his mind when awake. On the other hand, Prof. Bell contends that in dreams the moral sense is always asleep. The question is of the more importance since certain injudicious thinkers urge that the drunkard should be held irresponsible for his actions,—a fearful mistake.

The state of the senses in somnambulism is a point of much interest. The power of sight in the dark seems very acute; the pupil is dilated, and the sleep-walker thus sees objects with a degree of light which in a normal state appears darkness. It is maintained by some authorities, *e.g.*, Dr. Guy ("The Factors of the Unsound Mind"), that things are even seen by the sleep-walker "when cards or sheets of paper are interposed between the eye and the object to which it is directed." Our author takes a different view. He writes:—"What happens is apparently due to the muscular and tactile senses, and in some instances, perhaps, to the subject retaining in his mind a vivid representa-

tion, a mental image, of the writing which he had previously made. It is true that a somnambulist may write well though a sheet of pasteboard is interposed between his eyes and the writing-paper. If he has not crossed a *t*, nor dotted an *i*, and is requested to supply the omission, he may do so with great precision. But if the paper be shifted, his corrections are no longer in their right places on the paper, but wrong to the extent to which the paper has been moved."

A certain lady, named here Madame X, whose case was published in 1860 by M. Mesnet, wrote letters accurately in a room so dark that her physician could not distinguish the objects in it. "That she depended, however, upon her sight was shown by the fact that when an opaque body was placed between her eyes and the paper she stopped writing, and was much disturbed."

The sense of hearing is in some cases good, but in others is totally suspended. Similarly with smell, though one of the author's correspondents often in his attacks dreams of an escape of gas, and in his sleep searches for the gas-pipe, though there is no gas laid on in the house. There is often insensibility to pain, accompanied with an extreme delicacy of touch and an abnormal acuteness of the muscular sense.

Epidemic somnambulism is an exceedingly curious phenomenon, and not very rare.

Since at the present day "Mesmerism" has penetrated even to the Royal Institution, where a crocodile has been successfully operated upon, this work will prove exceedingly useful to all who are desirous of studying that intricate subject from every possible point of view.

A Treatise on Earthy and other Minerals, and Mining. By D. C. Davies, F.G.S. London: Crosby Lockwood and Co.

This volume is a practical handbook of those minerals which are in common life described as non-metallic. Thus we have here the "ores," as they are now called, of sulphur and of phosphorus, carbon and its compounds, silica, borax, and their allies.

Others of the minerals here described are in reality metallic, but the metals which they contain are not often used in the metallic state. Thus everyone now knows that barium, calcium, &c., are metals, but in the metallic state they are merely laboratory curiosities. Concerning sodium and aluminium doubts may be raised. The time is probably not distant when the latter, at least, may play a part almost as important in the free or metallic condition as it does in its salts. Such at least will be the opinion of all who have seen the beautiful alloys manufac-

tured by the Crown Metal Company, and considered the manifold applications of which they are capable.

Mr. Davies has evidently taken great pains in the compilation of this work, and the information given as to the occurrence, the properties, and the uses of the various minerals named, is, with very rare exceptions, absolutely accurate.

The account given of the phosphates, now so extensively used in the manufacture of chemical manures, is almost important and elaborate enough to form a distinct work.

We do not find any mention of the occurrence of vanadium in the iron-slags of Creusot, nor of its very important application in developing aniline-blacks in calico-printing. Bauxite is mentioned merely as a source of metallic aluminium, whilst its chief use at present is doubtless in the manufacture of sulphate of alumina and alum. In England and Scotland alum is rarely now produced from the alum-shales, as, though these contain a considerable quantity of sulphate of alumina ready formed, the cost of extracting it and freeing it from iron is such that china-clay and bauxite are preferred as the raw materials.

All persons interested in mining, quarrying, and the utilisation of mineral products will find this book an indispensable guide.

The Atheistic Platform. VIII. (Fortnightly.) "Is Darwinism Atheistic?" By CHARLES COCKBILL CATTELL, Author of "A Search for the First Man," &c. London: Freethought Publishing Company.

THE circumstance that Mr. Cattell is the Secretary of the Darwin Institute, Birmingham, combined with the plea of precedents (the fact that now and then this Journal does penetrate into subjects having *contact with* rather than *constituting* "science"), must furnish our excuse for drawing attention here to a page and a-half of English print into which is condensed more intellectual or moral obliquity than perhaps any other Darwinian applauder has yet contrived to compress into the same compass.

Mr. Cattell's aim is to deprive of force "a few phrases [which] are frequently quoted to prove" that Darwinism requires us to "speak of matter *endowed* with life, *endowed* with intelligence, &c.," rather than to "speak of living matter." This is done by collating the quotations with italic emphasis, as below, as to all organisms being "descended from some *one* primordial form," and as to "The Creator [having] originally breathed life into a few forms, *perhaps four or five.*" These "theological phrases" are "popular modes of expression."

Mr. Cattell then insists that Mr. Darwin "placed beyond all dispute" the falsity of the inference "that the use of the word Creator implies creation"; so popularity of mode of expression will scarcely explain the whole of Mr. Darwin's teleology.

Mr. Cattell now has recourse to a third means of invalidating these awkward popular modes of expression: they "must be judged by his later utterances"; and "with regard to organisms being the work of a creator, his later utterances in the 'Descent of Man' (p. 61) are very clear." But *what organisms?* "Species" *as such*—"separate creations"; in no instance the "elementary bit of moss," as we lately heard a lecturer on "Darwinism according to Darwin" (an applauder) word it. Mr. Cattell thinks otherwise. He thinks that Mr. Darwin "gives ample explanation of his use of current theological phrases" when affirming that he "was not, however, able to *annul* the influence of my *former belief*, then almost universal, that each species had been *purposely created*"; the inference being that Mr. Darwin is attempting to surreptitiously withdraw the "theological phrases" from the "Origin of Species." Mr. Cattell having specified the page, let the reader run and read—and blush. But *if* the popular "modes of expression" *were merely* the residue of an earlier Cuvierism, as we believe Prof. Haeckel would say, why do we find in almost identical language in the edition of the "Descent of Man" of 1871 the alleged tacit withdrawal of phrases retained in the "Origin of Species," sixth edition, with additions *and corrections down to* 1872"?

Mr. Cattell considers, further, Mr. Darwin's later utterances: his remarks somewhat assimilating to the nature of an imputation of deceit. He writes:—"With regard to the existence of a creator and ruler of the universe he says, 'This has been answered in the affirmative by some of the highest intellects,' but he does not answer it himself"; and adds in a foot-note—"In conversation with Dr. Aveling he preferred to describe himself as an 'Agnostic,' which means *I don't know*"—the best answer anyone can give in these days when asked what "Agnostic" means. Then, evidently to confirm the view that Mr. Darwin despised superstition, he relates that "He mentions a savage who with justifiable pride stoutly maintained that there was no *devil* in his land." Now unless Mr. Cattell believes that Mr. Darwin's "considerateness for the feelings of others" (as he styles it) would have induced him to wilfully deceive men concerning this or that "ennobling belief" (for the evidences of Mr. Darwin's theism are—for those who believe he entertained any respect for truthfulness—not confined to one quotation amongst either his earlier or later utterances, but are legion), surely such assimilation of an imputation of deceit is unwise. If Mr. Darwin be now experiencing that immortality which in the "Descent of Man" he seemed to regard as axiomatically established (referring his readers in a foot-note to a work by a gentleman who wrote

a Catechism of the Gospels the year the "Origin of Species" was published, and who, when the "Descent of Man" appeared was Pastor of St. Thomas's Square Chapel, Hackney; but who has—the day this review is sent to the Editor—been elected Member for Leicester), his prayers will include "Save me from my friends!"

Mr. Cattell remarks upon Mr. Darwin's "freedom from dogmatism," and tells us that "He traces the objections to his theory to the 'arrogance of our forefathers, which made them declare that they were descended from demi-gods,'"—a sentence differently quoted by Dr. St. George Mivart on more than one occasion.

Corpulence, and its Treatment on Physiological Principles. By Dr. W. Ebstein. Translated from the Sixth German Edition by Prof. A. H. Keane, B.A. London: H. Grevel.

We have here a work differing widely from the well-known treatise of Banting. Prof. Ebstein investigates physiologically the causes, the conditions, and the collateral effects of that state of body known as corpulence or, in its more extreme stages, as obesity. He shows that the phenomenon in question, though regarded as pathological, and as therefore to be cured, is not marked off by any sharp boundary from the normal condition. In a healthy new-born child the proportion of fat ranges from 9 to 18 per cent of the entire weight. In adults the normal proportion, according to Béclard and Quernay, is 5 per cent for men and 6 for women. We find a notice of the discussion whether the fixed connective tissue cells and the adipose cells are identical, or whether, as Toldt maintains, the fatty tissue of vertebrate animals is a special organ. All observers, however, still agree that every connective tissue cell may under certain conditions be transformed into a fat cell. The liver is the only organ which ever under physiological conditions accumulates fat, and it is the one which most readily passes into the state of fatty degeneration.

In opposition to a very common error Dr. Ebstein maintains that the hurtful influence of corpulency on mental activity has been much over-rated. He shows, however, that as regards health its ill effects are often overlooked. Obesity in its more advanced stages is always accompanied by anæmia, and very frequently by gout and diabetes.

As regards the practical treatment of corpulency the author shows that the remedies often recommended are sometimes injurious, or merely temporary in their action, and sometimes fail altogether. Inaction is generally and rightly supposed to promote corpulence in man, as it aids the fattening process in swine,

oxen, and poultry. The "starvation remedies" are very justly rejected, because while we are starving we lose albumen as well as fat. Excessive bodily exercise is also ineffective. Banting in his confessions tells us that he rowed a heavy boat for a couple of hours daily and gained muscular power, and also a very hearty appetite. As he yielded to its demands he still increased in weight.

There is a condition powerfully opposed to corpulence which Dr. Ebstein does not directly mention, though he refers to its antithesis as promoting fatness in men and in the lower animals. There are few persons advanced in life who will not agree with us that in the first, and even in the second quarters of the present century corpulency was not a perfectly normal feature among Englishmen who had reached their fiftieth year. The "fair round belly"—whether or not "with good capon lined"—was prevalent among country gentlemen, clergymen, publicans, tradesmen, &c. This is now evidently no longer the case. The cause of the change is not an increased amount of bodily exercise nor a more rational diet. It is simply anxiety—work under pressure. But though this is the surest remedy, or rather preventive, for corpulency, it is one which no physician would recommend to his patients. For the author's own system of treatment, which seems judicious, we must refer our readers to the work itself.

In an appendix we find reference to the case of Cornaro, who from his fortieth to his hundred-and-fourth year restricted himself daily to 12 ozs. of bread, yolk of egg, meat, and soup, along with 14 ozs. of liquid. As the author remarks, Cornaro does not state whether he was corpulent or lean at the time when he adopted this strict regimen. It may be added that he makes no mention of his subsequent habits. If his life was spent in inactivity we need not wonder that he found a slender fare beneficial.

Spectrum Colours, Colour Sensations, and After Images. Suggestion for Extending the Dynamical Theory. By G. St. Clair, F.G.S. Birmingham: Herald Press.

This memoir, reprinted from the "Proceedings of the Birmingham Philosophical Society," has been courteously forwarded to us by the author. In it we find some considerations on colour which, in our humble opinion, merit the attention both of the physicist and of the physiologist. The author, after giving a table of the vibration-numbers of the spectrum colours, asks if it is not anomalous that while these colours are a regular series and pass into each other by slow gradation, three of them should deserve to be called primary, and the other four secondary or derived.

He next points out that whilst according to the current theory of colours and colour sensations—that of Young and Helmholtz—we have three colour sensations, yet the latter authority admits that for the present the theory lacks anatomical basis, as no such distinction of fibres can be traced in the retina. He then proposes to take two colours of the spectrum and to add their wave-lengths together, thus obtaining the intermediate length. Thus the mean between yellow and red is almost identical with the wave-length of orange, the intermediate colour. Now it is commonly said that if all the colours of the spectrum are added together they make white light. But if we add together the wave-lengths of all the seven colours and take their mean, we get 0·0000213, which falls between the yellow and the green. This, the author says, is "just where the eye would lead us to expect it. White would therefore appear to be a colour of the spectrum, occupying the medium place, though not always showing plainly, because of the narrowness of its band." The fact that the union of the blue and yellow rays of the spectrum produces white and not green is pronounced by Helmholtz the most striking difference between a mixture of pigments and a mixture of coloured rays. Starting from these facts, Mr. St. Clair disputes the theory of three primary colours. He writes:—"Violet and red should not be regarded as simple colours on the mere ground that they cannot be found by compounding two others. Being at the extremities of the scale neither of them is a mean between two others—no two wave-lengths in the scale, on being added together and divided by two, will yield a value so high as 0·0000256 (red), or so low as 0·0000174 (violet)." Concerning green he quotes Prof. Tyndall, who states that C. E. Wünsch, on mixing yellow with bright blue, obtained a white with a greenish tinge.

The ordinary theory of after-images is not free from difficulties. "If we have been looking at a red patch, and then on turning our eyes away see a patch of blue-green, we are asked to believe that we have fatigued one of the primary colour sensations and made ourselves temporarily blind to red, so that in looking at a white background the affected portion of the retina can only discern the green complementary." Mr. St. Clair, however, brings forward an objection which Mr. S. Hodges also entertains:—"If after we have gazed for thirty seconds at a red patch the retina, or any set of rods there, is so exhausted that it can no longer perceive red rays, it ought to cease to see the red patch when we continue looking at it for more than thirty seconds, which is not the case." Here, however, these writers are both in error. In "matching off" scarlet, magenta, &c., cloths, dyers find it necessary to use great dispatch. If the eyes are fixed on such colours for any length of time fatigue is certainly experienced, and the dyer becomes unable to tell whether he has hit the exact shade required or not.

Another objection to the theory of fatigue is more valid. "It is most difficult to believe that the retina is fatigued by looking at black, since blackness is equivalent to the absence of stimulus, and yet after looking at a black object on a white ground we see an after-image of white on a black ground."

We regret that we cannot enter further into this interesting memoir. Many portions of this require and would repay experimental investigation.

Victorian Year-Book for 1882-3. By H. HEYLYN HAYTER, C.M.G., Government Statist of Victoria. Melbourne: Ferres. London: Robertson.

MUCH of the most interesting matter in this publication, such as the meteorology, the topographical features, &c., has already appeared in the issues for former years. The only novelty is to be found in the records of social and economic phenomena.

Under the head Statistics of Suicide we find a passage worth quoting. Dr. Enrico Morselli, Professor of Psychological Medicine in the University of Turin, after a careful and prolonged inquiry, concludes that suicide is increasing in almost every country; that religion and morals have never reached the root of the calamity; and that the sole preventive, not only against suicide but against madness, would consist in "diminishing the struggle for life amongst men."

The following consideration may serve to moderate the dislike to Chinese immigrants entertained in the colonies. Whilst in 1882 the proportion of persons of English birth arrested for crime was 43·64 per 1000, that of Scotchmen 46·69, and that of Irishmen 83·20, the Chinese were only in the proportion of 18·07 per 1000.

The cultivation of the vine seems to be extending, though the *Phylloxera* made its appearance as far back as 1875, and many vineyards have been in consequence rooted out. The growth of the mulberry and the olive is not increasing, as it might and should. It is unpleasant to see among the imports of such a region "olive and salad oil," "currants and raisins," "jams, jellies, and preserves," and not a few kindred items.

As a very exceptional climatic phenomenon it is recorded that on July 26th, 1882, there occurred a fall of snow at Melbourne, the lowest temperature in the shade being 37° F. and the highest 44° F. No other snowfall had occurred since August 29th and 30th, 1849.

Collins's Advanced Science Series. Mineralogy. By J. H. Collins, F.G.S. Vol. II. Systematic and Descriptive Mineralogy. London and Glasgow: W. Collins, Sons, and Co., Limited.

Of all departments of natural science Mineralogy is probably the least generally popular. It has not shared in the impulse given to Botany and Zoology by the Darwinian reformation, and outside a very limited circle it has neither friends nor enemies. The author, in his Preface, pronounces it to be "little more than a dictionary of minerals," and as such it may be considered accurate and complete.

The classification adopted is essentially that of Dana, Brooke, Miller, and Nicol, somewhat modified by the author. The mineral species are arranged under the heads of Native Elements, Pyritoids, Haloids, Chlorides, Spathoids, Silicates, and Hydrocarbons.

An Appendix gives the meteoric minerals, and certain minerals whose composition is either indefinite or has not been properly ascertained.

The work, like almost every scientific manual published in England, is written with reference to the "Science and Art Department," but it has the more satisfactory feature of being also adapted to the use of practical working miners, quarrymen, and field geologists.

CORRESPONDENCE.

. The Editor does not hold himself responsible for statements of facts or opinions expressed in Correspondence, or in Articles bearing the signature of their respective authors.

HYLOZOISM AND HYLO-IDEALISM.

The supporters of any thesis which tends to revolutionise current ideas ought to give a patient hearing to every opponent, however gross may be his misconceptions and however abusive his language. I hope soon, with your kind permission, to answer Mr. Billing's late articles on Hylo-Idealism. At present I have only time to comment very briefly upon the letter of your correspondent "F. P. L." He falls into the usual confusion between the world as appearance and the world as actuality. Mountains, rivers, and seas, sun, moon, and stars, and the *phenomenal* human brain, are fashioned into the forms which we know by the *actual* human brain. What I find "nauseous" is the minification of man in comparison with the phenomenal universe which he procreates. The actuality of things is unknown to us, save by its manifestations in the sphere of sense and thought; but I have tried to show that these manifestations distinctly negative dualistic theories. I refer "F. P. L." to articles on "Animal Automatism," "The Identity of Vital and Cosmical Energy," "The Philosophy of Thomas Carlyle," in the "Journal of Science" for April, May, and June, 1882, and to "The Brain Theory of Mind and Matter" in the issue for March, 1883.

C. N. (Constance Arden).

THE TREATMENT OF LONDON SEWAGE.

Many complaints have been made that nothing was done towards the purification of the immense volume of sewage poured into the Thames at Crossness and Barking Creek with every turn of the tide. Something is being done at last, and that something, if it effects nothing else, will make a very handsome addition to the present outlay without the possibility of any set-off. Chloride of lime, I believe from 100 to 180 tons daily, is being put into the river. As this material is worth £9 per ton,

the extra cost, at the lower figure, will be £328,500 yearly,—a heavy outlay for an injudicious measure. I call it injudicious because chloride of lime, though it may for the moment suppress or mask the evil odour of the sewage, will not remove from it the putrescent or putrescible matters, and unless this is done I need scarcely say that there can be no true and permanent purification.

Further, chloride of lime in rivers is itself a nuisance. It and its kindred compounds were specially noted in the "Recommendations" of the late Royal Rivers Pollution Commission as to be excluded, or at least kept within very narrow limits, amongst other grounds because it is fatal to fish. Disputes between riparian proprietors and the owners of paper-mills on this very subject are not infrequent. It is again to be remarked that chloride of lime and carbolic acid are mutually incompatible. Yet we see now the sanitary officials of the vestries pouring carbolic acid down public urinals, &c., whilst the Metropolitan Board of Works uses the conflicting ingredient at the outfalls, the ratepayers, of course, finding the funds for this unscientific procedure.

Argus.

TECHNICAL TRIALS.

I have not at present time to reply in full to the acute letter of "Nomikos." Much of it, however, relates to matter which lies outside both your cognizance and mine. A Homœopath defendant *qua* Homœopath is too rare a phenomenon to be taken into account. I am not aware of any scientific man who objects to Patent Laws as such. The persons who would do away with patent-right are lawyers, merchants, bankers, and the like. Should even some day a distinguished chemist or physicist, "without faith in the Patent Laws," turn up, it is scarcely likely that his objection to a system would interfere with his judgment as to the novelty or the feasibility of a process. There are scores of matters which might possibly form the subject of legal proceedings on which text-books are dumb.

In the cases of technical language which "Nomikos" brings forward there are synonyms intelligible to the public; but in many cases the technical term is the only one in existence for an object or a process, so the difficulty of explaining its meaning to outsiders is not small at any time, and is greatly increased by the system of examination and cross-examination.

An Old Technologist.

NOTES.

At the last meeting of the Entomological Society Mr. Waterhouse exhibited certain Coleoptera which had been exposed to the light, in show-cases, at the British Museum, in comparison with recent specimens of the same species. The change of colour was in some cases complementary, *e.g.*, in *Eurhinus cupreus* and in *Parapleura bacca*, from a fiery red to green.

An informal meeting of naturalists has recently been held at the British Museum to discuss the proposed introduction of a ternary nomenclature in place of the present binary (Linnæan) system. No resolution was proposed, but we may say that generally the innovation was supported by the ornithologists and opposed by the entomologists.

A special laboratory has been opened at Munich for the study of Bacteria.

The results lately obtained by Mr. Eglinton, at St. James's Hall, are simply astounding. Two clean slates are tied together with a morsel of pencil between them, and are held in such a manner that the medium cannot touch the inside with any part of his person. Yet a sound of writing is soon heard, and on unfastening the slates they are found covered with writing within!

Dr. Miklucho Maclay ("American Naturalist") states that the temperature of the body in *Echidna hystrix* is only 78° F.—much below that of normal mammals.

The "Courrier Medical" describes a fatal case of hydrophobia from the bite of a dog evidently not rabid. The patient had been bitten slightly, about three months before his admission to the hospital, by a pregnant bitch which was not mad, and which had since brought forth and suckled a litter of puppies. The owner of the animal admitted that this bitch when pregnant was evil-disposed, and attacked men and animals, whilst she had never been mad nor otherwise ill. The fear of hydrophobia was evidently not the cause of the symptoms observed, since the patient attached no importance to the bite which he had received, and did not even connect it with his illness. The writer adds that "it is prudent to mistrust dogs and cats when in the state

of heat or of gestation, and when sick, and also when they become quarrelsome."

Colonel W. Hope, V.C., speaking of Government officials, says :—"Judgment and common sense they may be wanting in, but school-boy competitive-examination smartness they have any quantity of."

Mr. G. Brown-Goode ("Science") defends Dr. Günther against the charges brought by Prof. Gill. He shows that the *Challenger* collections have not yet become the property of the British Museum, but are merely held in trust by Dr. Günther for the Lords of the Admiralty.

A "Christian" organ, whilst complaining that trade, art, and "dissent" are not, as such, represented in the House of Lords, does not regret the comparative absence of Science in that august assembly.

Mr. W. R. Tomlinson, M.A. ("Light"), writes :—"I have long thought that the late Charles Darwin, who was a Scripture student, must have got his material ideas of the 'survival of the fittest' from the spiritual teaching of the Bible concerning the conditional immortality of the soul."

Mr. S. H. Trowbridge ("Science") records the capture of a shovel-nosed sturgeon (*Scaphirhynchops platyrhynchus*) which "exhibited on the surface no sign whatever of eyes." This species of fish ploughs in the mud for its food, and has little apparent use for eyes. Hence, as the author thinks, they are becoming obsolete.

MM. Pasteur, Chamberland, and Roux ("Comptes Rendus") consider that they have at last developed a vaccine for rabies. They have called upon the French Minister of Public Instruction to nominate a commission before whom the crucial demonstration is to be performed.

Mr. J. E. Jeffries ("Proc. Boston Natural Hist. Soc.") combats the current idea that scales, feathers, and hairs are identical in Nature.

M. A. Chauveau ("Comptes Rendus") considers it fully proved that condensed oxygen, as well as heat, attenuates the activity of virulent microbia. The precise degree of condensation is, however, the important point.

It is an error to suppose that the vapours of phenol, even when so strong as to be scarcely tolerable by human beings, will drive away the house-fly.

Dr. S. Lukjanow ("Zeitschrift für Physiol. Chemie") has demonstrated that the absorption of oxygen by animals is not a

function directly dependent on the oxygen-tension of the air, yet under certain circumstances the organism has the power of taking up from an atmosphere abnormally rich in oxygen more of this element than from common air.

Mr. Theodore Gill (" Science ") complains emphatically that, though the deep-sea fishes of the *Challenger* Expedition have been in the hands of Dr. Günther for eight years, eminent ichthyologists are still refused access to them.

An " Anti-Vivisection Society " has sprung up in America. In reply to one of its manifestoes the Pennsylvania Medical Society adopted a resolution emphasizing the usefulness and necessity of physiological experimentation.

We are glad to learn that the " Illustrated London News " and the " Dispatch " have come forward in defence of physiological experimentation. These papers reach thousands of intelligent persons who never take up a medical or other scientific journal. The " Dispatch " says truthfully—" The Act of 1876 has resulted in almost extinguishing original physiological research in this country."

According to Dr. Pehl, bacteria in water may be very greatly reduced in number by keeping it in rapid motion.

The fifty-seventh meeting of " German Naturalists and Physicians " will take place at Magdeburg from the 18th to the 23rd of September.

The coming meeting of the British Medical Association at Belfast still occasions some disputes and heartburnings.

During the year 1883, according to the annual report just issued to Parliament, five hundred and sixty-nine experiments were performed on living animals in the United Kingdom, thirty-four of these being carried out in Ireland. Fifty-five experiments were performed without anæsthetics, and one hundred and twenty-two under certificates giving permission to preserve the life of the animal after recovery from anæsthesia. Concerning this last class of experiments the report states that in one hundred and fourteen cases the operation consisted of inoculation with various septic matters or morbific organisms, for the greater part connected with an important inquiry into the nature of tubercular affections. No pain was inflicted in these cases except in about fourteen or fifteen instances, in which disease was produced, but which was very trifling. In the remaining eight cases, in which more serious operations were required, as these were effected under anæsthesia, the only suffering in the animals that survived would be that which attends the ordinary repair of a " surgical injury."

Dr. Testut laid before the French Academy of Sciences an account of the dissection of a South African Bushman. Several Simian characteristics in the arrangement of the muscles were pointed out; yet M. de Quatrefages, strangely enough, thought proper to regard these facts as arguments *against* the animal origin of man!

M. V. Marcano ("Comptes Rendus") has observed that plants in tropical regions evaporate during the night (from 6 p.m. to 6 a.m.) a quantity of water equal to that which they exhale by day. The daily evaporation takes place chiefly in the morning, the maximum being generally between 10.15 a.m. and noon. The hygrometric condition of the atmosphere has no decided influence on this phenomenon.

According to Rossi ("Giornale della Accademia di Medicina") not only the Cantharidæ, but the Cetoniadæ, and hence probably other groups of Coleoptera, secrete cantharidine.

P. Giacosa ("Revista di Chimica") states that beetles (group not mentioned) contain 7·7 per cent of fatty matter, which melts at 29° to 30° C., and contains 73·6 of carbon and 11·4 of hydrogen.

It is noteworthy that the best solvent for cantharidine is formic acid,—a very frequent secretion among insects.

MM. Gautier and Etard consider the odour of the ptomaines similar to that of whitethorn or sloe blossom.

M. F. Krasen ("Ciel et Terre" and "Annuaire Botanique") seeks to demonstrate that certain anomalies in the distribution of plants, according to altitude, must be due to a comparatively recent change in the elevation of the mountains on which they grow.

In the official report issued by the Sanitary Board of Paris, in view of a possible visitation of cholera, the public are cautioned against raw vegetables, especially those cultivated on the great sewage-irrigation farm of Gennevilliers! What will be said in Croydon?

Mr. L. F. Ward ("Science") asks strangely:—"Why, then, does not politics form a legitimate subject of scientific investigation? Why might not its discussion in strictly scientific societies and journals be permitted and encouraged?" We reply, Because there is already far too much of such discussion; that it already absorbs too great a share of public attention—especially since 1876—to the disadvantage of Science; and because such "permission and encouragement" would drive away men of things and substitute for them wordmongers.

Mr. S. Newcomb (" Science "), in criticising President Eliot's views on a "liberal education," outdoes Procrustes. He suggests that "the end will be best reached by adopting a system of training for every man in that class of subjects for which his natural capacity is the weakest!" Surely a "community and sympathy of thought and feeling among the great body of educated men" would be far too dearly bought on such terms!

M. Montigny maintains that the occurrence of blueness in the scintillation of the stars serves, to some extent, as a measure of the quantity of water contained in the upper regions of the atmosphere.

The *Narcissus reflexus* of the Glenan Islands is polymorphous, presenting a form with the style long and the stamens shorter; a second form in which the style is short and the stamens longer; and a third, very rare form, in which the three internal stamens are abortive.

H. H. Smith (" American Naturalist ") mentions a Longicorn genus (*Scorpionus*), found in South Brazil, which can inflict a sharp sting with the terminal joint of its antennæ.

The "American Naturalist" mentions that a farmer in Arkansas was stung to death by the "buffalo gnat,"—a species of *Simulium*.

The "Medical Press and Circular," speaking of the Medical Bill at present before Parliament, says that Messrs. Hopwood and Wyndham have amendments for the encouragement of quackery, which need not be seriously considered.

Perfectly pure albumen does not coagulate at 212° F., and forms no precipitate with the salts of barium.

We perceive that the Chemical Society of Paris proposes to assume the title of the "Chemical Society of France."

According to the "Scientific American" it would require four thousand years for the waters of the Mediterranean to fill the valley of the Jordan, if admitted through a channel 100 feet wide by 25 feet in depth. At the same rate it would take 40,000 years to fill up the Caspian to the sea-level, and thousands of years to fill up the Sahara.

[As by far the greater part of the Sahara is above the sea-level the author's calculations are evidently ill-founded in this respect.]

Dr. C. G. Garrison (" Medical Bulletin ") contends that "as expert the position of the physician is judicial, and he should be called by the Court, not by the contestants."

[The same must, by a parity of reasoning, be the case with the microscopist, the scientific chemist, and the engineer.]

Says the "Medical Times and Gazette"—"There are two considerations that will give additional importance to M. Pasteur's discovery, should it prove to be a genuine one. In the first place it will immensely stimulate research in connection with analogous diseases, for which it is to be hoped a similar preventive may be found. . . . In the second place, M. Pasteur's success will be a blow to the anti-vivisection agitation. It will make, or ought to make, every dog-lover the friend of experimental physiology; for even the most rabid anti-vivisectionists must admit that rabid dogs would in all probability have existed to the Greek Kalends, if they had had their way in France as well as in England."

The Abbé François Moigno, for many years editor of "Cosmos les Mondes," died on July 13th. If, on the one hand, he was an obstinate opponent of Evolution, he merits great honour, on the other, as a champion of free Science against bureaucracy.

Dulau & Co.

6.8.84.

TWENTY-FIRST YEAR OF PUBLICATION.

THE

JOURNAL OF SCIENCE,

AN ANNALS OF [illegible]

[illegible]

POST TENEBRAS LUX

Vol. VI. [illegible]
No. CXXIX.

SEPTEMBER 188[illegible]

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LONDON

[illegible] HORSESHOE COURT, LUDGATE HILL

[illegible] addressed.

PRICE ONE SHILLING AND SIXPENCE

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THE

JOURNAL OF SCIENCE.

SEPTEMBER, 1884.

I. "ULTIMATE RELIGIOUS IDEAS."

THE ABSOLUTE, THE INFINITE, THE CAUSE.

By S. Billing.

MR. SPENCER, in his work on first principles, title "Ultimate Religious Ideas," makes comments on the origin of the Universe, the Absolute, and on Religious creeds. The arguments admit a few remarks.

If we accept the rigid rules of Logic, thought itself is unthinkable, or at all events not understandable. In the article in question we are told—"The atheistic theory is not only absolutely unthinkable, but even if it were thinkable would not be a solution." As common sense understands Atheism it is the basis of the article from end to end. Before the article commences we are warned that "Students of philosophy will find in them much that is more or less familiar; and to most of those who are unacquainted with the literature of modern metaphysics they may prove somewhat difficult to follow,"—*i.e.*, the hypotheses as interpreted by Mr. Spencer and his compeers. They appear capable of being followed by anyone at all conversant with the old school of metaphysics, but are quite as inappreciable, in the same sense, as the possibility of understanding that "Judgment" is an "*altruistic sentiment.*" No one would know, unless upon such high authority as a new school philosopher, that judgment was a sentiment, for it, by common consent and the general conception, is always considered to be a reasoned conclusion (*see* "Mind," No. 1). There does not appear, either in the argument or the ideas, much that is new.

"In excluding the ideas of an antecedent cause" "we exclude the idea of a beginning." "The push and the pull" (Faraday) are admitted by Science, and surely that which Science admits it is at the least supposed to admit on proof. The admissions of Science are not only thinkable, but usually are reasons drawn from facts. Suppose we were to go on seeking for the antecedent of the push and the pull, it would be seeking for an antecedent without an antecedent. A pause must come when that point is reached beyond which the finite mind cannot penetrate. It is sufficient that there is a something behind. It is impossible to suppose that the push and the pull are self-imposed, or self-existing, because we know they can be simulated by the will of man; and as we know what human willing does, it is quite thinkable to imagine an antecedent of the push and the pull which impulsed it to form the world, and to go further, the Universe.

"Respecting the origin of the Universe three verbally intelligible suppositions may be made"—"*Self-existent,*" "*Self-created,*" and "*Created by an external agency.*" The deeper question into which this finally merges "is whether any one of them is even conceivable in the true sense of the word?" "By self-existence we mean an existence independent of any other—not produced by any other." Although in our finite reasoning we cannot conceive an existence without a beginning, it is possible to conceive an existence whose beginning by no process of reasoning (available to us) we can account for, and therefore to our perceptions has no beginning. The conception is thinkable, although unfathomable.

"The hypothesis of self-creation practically amounts to what is called Pantheism,—is similarly incapable of being represented in thought." "We cannot form any idea of the potential existence of the Universe as distinguished from its actual existence," "for to conceive self-creation is to conceive potential existence passing into actual existence by some inherent necessity." "To think such a thought is to think of a passing into another form without additional impulse," and "involves the idea of a change without a cause." "This does not stand for real thought, but merely suggests the vaguest symbols without any interpretation."

Self-creation as applied to natural phenomena, if the teachings of Science are regarded, cannot be supposed, for Science—although it does not attempt to explain it—teaches there is an impulse. An impulse implies a motor; then the motor, so far as we know, is the cause of creation. When we see the facts of things we by reasoning arrive at a potence which becomes actual by development. It follows that

creation, by whatever means it was evolved, contains within itself the potence of development, and the application of this principle extends from the minutest thing to a Universe.

To carry out the reasonings adopted by Mr. Spencer :— It would seem we cannot represent in thought that of which we know not the beginning. We are conscious of intelligence, but we do not know its origin. We have present with us, as facts, life energies (living things), but we know not their whence; the Science of Huxley and the Materialism of Häeckel are equally at fault. We handle the seeds of plants; we know (generally) what will result from them, but we know nothing of their hidden and regulating potence—why an acorn should develope into an oak, or why the winged integuments of the dandelion should reproduce its parent. In animal generation the mystery is the same; we can follow the processes of formation, but we know nothing of the directing energy through which the result is determined. There is no lack of examples; we see the origin, but know nothing of the pusher and puller. The fact (worth a million of hypotheses) that the naturalist attempts to account for the various results is at least a proof that they are capable " of being represented in thought."

" Creation by external agency," that is " that the genesis of the heavens and the earth is effected somewhat after the manner in which a workman shapes a piece of furniture." " This assumption is not that of theologians only, but of an immense number of philosophers, both past and present. It is found in the teachings of Plato, and in the writing of not a few living men of Science." " The conception is not even consistent in itself, and cannot be realised in thought when all its assumptions are granted."

If an assumption *is* granted it must be conceived for the purpose *as* a *fact*, and can be realised in thought even although the basis on which it is built be utterly false, for the concession does away with all difficulty in the way of proof. If creation means such external agency as quoted in the text (carpentry), reasoning on things would pronounce it to be without foundation; for if it were true, the lines in the wings of an insect, as well as the delicate tints of colour on the wings of a butterfly, or the more stupendous mechanism of Nature, would all owe their advent to such an act. Such a conception appears, when examined, to be impossible; but if a more rational view be taken, and one more consistent with the notion of Deity and the facts of Science is presented,—*viz.*, a creation by law and from a germ projected with the genesis of phenomena,—then creation by external

agency is both conceivable and thinkable, and creation in such an exposition is accepted by many theologians and philosophers.

The assumption of carpentry is somewhat beside the question, as also are the assumptions of theologians and philosophers. We have the facts of this genesis in phenomena; we have the thing, but we do not know the whence and the why of the thing. The supposition as "a workman shapes a piece of furniture" is not consistent, for it is the assumption of an hypothesis of which there is no possibility of proof. In Nature we find gigantic systems of mechanics and a wondrous chemical apparatus all working to the same end, each without manipulations and by the impulsion of an internal potency.

The propositions "Self-existent," Self-created," and "Created by an external agency," in the sense of the text to me appear to be the same, the difference being in their statement. This, further on, Mr. Spencer appears to admit, but at all events to one and all is attached the mystery of their origination. It is so easy to propound subtleties impossible of answer. Mr. Lewes has taught us the difference there is between imagination and conception.

The conception of a God is the gradual growth of human thought, whatever may have been the source of the primitive idea; perhaps it might be found when the Old World men heard in the thunder "the hammer clang of a God," or in the gentler assumptions of the Vedic worshippers,—"that in the brightness of light and the benefits showered on man by the vivifying effects of the sun were seen the acts of a beneficent power, which man's gratitude or superstition deemed to be divine." Religious thoughts, as well as scientific thoughts, require development, and had there not been some *innate* sentiment in the mind corresponding to what is called religious thought,—"the sentiment of religion,"—which had a development long before Anaxagoras* admitted the conception of a Supreme Being and more perfect as thought than those found in the theses of Plato. There may be an analogy between the process of manufacture and the process of a creation, but John Stuart Mill teaches there is a great distinction between analogy and induction.

The general belief among men is of a self-existent cause, or God; but a created Universe is a different conception to the

* Anaxagoras was the first of the Greek philosophers who propounded the sublime idea "of one harmonising intelligence. The νους, however, became a moral providence only in the hands of Socrates" (Dr. Nichol). In India the idea long preceded that of Anaxagoras.

assumption of the text, which, under the cover of the creation of the Universe, assumes there is no efficient cause. In supposing "the great artificer, we suppose merely that certain pre-existing elements were thus put into their present arrangement." Spencer continues, "Still more manifest does the insufficiency of this theory of creation become when we turn from material objects to that which sustains them, when instead of matter we contemplate space." "Space was made in the same manner as matter was made, and is not to be got rid of." "If the non-existence of space is absolutely inconceivable, then necessarily its creation is absolutely inconceivable." Consciousness and space are one; there can be no outside, for where space is consciousness is. Space is an existing conception of the finite; there is no possibility of imagining space without at the same time consciousness being present (*vide* Kant).

After descanting on the third presented hypothesis he concludes "it is useless, as it commits us to an infinite series of these agencies. By the second we are practically involved in the same predicament." "Since self-creation implies an infinite series of potential existences we are obliged to fall back on the first, which is the one commonly accepted and commonly supposed to be satisfactory." That is, self-existence,—thus the potence of Tyndall becomes the actual of Spencer. "Those who cannot conceive a self-existing Universe, and who therefore assume a Creator as the source of the Universe, take for granted they can conceive a self-existent Creator." "Self-existence is rigorously inconceivable," "the Atheistic hypothesis is untenable if it contains the same impossible idea." "Evidence proves that the elements of these hypotheses cannot even be put together in consciousness." Surely this is a violent assumption. We speak of causes as producing results. The wind scatters the leaf (cause and effect). Is it because we trace results to causes we are therefore to assume a cause for the originator of the Universe? We cannot get behind the mechanism of the Universe and behold its originator. We can therefore conceive no cause beyond such a cause. Hence arises the conception of an uncaused cause, or, as Aristotle puts it, an unmoving centre.

The three conclusions—Atheistic, Pantheistic, and Theistic—"contain the same ultimate element." "It is impossible to avoid making the assumption of self-existence somewhere, and whether that assumption be made nakedly or under complicated disguises it is equally unthinkable." "If from the origin of the Universe we turn to Nature,

the same difficulties under new aspects 'arise.' We are compelled to make assumptions, which assumptions cannot be represented in thought." "We cannot think at all about the expressions of the eternal world without thinking of them as caused," nor "carry out an enquiry concerning them without accepting the hypothesis of a first cause." "To think of the first cause as finite is to think of it as limited," and "implies a conception beyond its limits. If limited there is something outside of it." "This something must have no first cause, must be uncaused." "If we admit there can be something uncaused there is no reason to assume a cause for anything." The assumption must be infinitude. "It must be independent"—an implication of necessity implies dependence—"if the presence of any other existence is necessary"; "there can be nothing in it which determines change, and nothing which prevents change." "If it possesses anything which implies restraints or necessities it is not 'a first cause.'" "Thus a first cause must be in every sense perfect, complete, total, including within itself all power, transcending all law, or absolute." In our search we arrive at "the hypothesis of a first cause, and we have no alternative but to regard this first cause as infinite and absolute." These reasonings and results we are told are illusive, and "are merely symbolic conceptions of an illogical order."

If every fact is to be proved by rigid logical formularies, then God, Intelligence, Perception, Conception, Phenomena, the Universe in its multitudinous grandeur, Galaxies, Systems of Suns and Worlds are all illusions. We dwell in a paradise of nothingness—a consciousness creating its own impressions, the *alpha* and *omega* of all things. Apply the reasonings of Mr. Spencer to the most trivial fact—it is non-existent:* all becomes the necessity of nothingness.

The arguments concerning the absolute, adopted so far as they serve Mr. Spencer's illustrations, are those used by Dean Mansell ("Limits of Religious Thought") in his comments on Sir Wm. Hamilton. He says (for the full argument the reader is referred to this work):—The "three conceptions, the Cause, the Absolute, the Infinite, all equally indispensable, do they not imply contradictions to each other when viewed in conjunction as attributes of one and the same being?" Such is the proposition in its nakedness. The difficulty throughout the whole argument appears in

* Archbishop Whately's amusing study in logical metaphysics, *viz.*, questioning the existence of Napoleon, may be studied with profit.

considering these principles as attributes. If viewed as merely attributes, and not as one principle differently designating the same being, they seem to imply contradiction.

Why are these, said to be "indispensable" qualities, to be viewed as attributes, which when conjoined as one being contains within itself the substance of all: there are no opposites? We might as well, in describing anything which has various designations, call these designations attributes, and treat them as opposites although each designation is the consistent whole, notwithstanding its nomenclature. View the attributes as constituting the entirety of a being coming into existence at the same moment as a whole. We are then rid of the intolerable finesse of the Absolute, the Infinite, the Cause. Whether it be by Sir Wm. Hamilton, Dean Mansell, or Mr. Spencer that the distinctions are raised, they appear to have their consummation in the desire which exists in the minds of many to make that which may be the simple, the complex by rules of logic (setting apart the idea that the finite can never comprehend the infinite). There appears to be no necessity in the premiss to consider the three other than as a consolidated whole. Why should they be marshalled as opposites? It serves no purpose in the conception of a God, for attributes are but emanations, although each viewed in its integrity has the significance of a complete whole. We may *differentiate* phenomena, but it seems an absurdity to differentiate that which in its own substance and consistency is all things. I may cause an effect; surely it will not be said the effect is opposed to the cause, or can usurp its place as a cause; it is a mere result from an existing something which may be done, or not done, as the operator wills. If the three flow from the one and constitute the one, the aspects become and are the thing, as consciousness, intelligence, will. It may be intelligence in one sense, will in another, but all the aspects are recognised in consciousness. If an absolute is conceived, there can be neither conditions nor parts. It is not because a cause is contained in the absolute that the cause is so conditioned (*i.e.*, a cause as an infinite projection) that it ceases to be a part of the absolute from which it emanates. So with infinite or infinitude; it is but a principle contained in the absolute. It is said "a cause as such cannot be absolute, nor the absolute as such a cause;" but if the cause is an effect of the absolute there is no reason to suppose the cause is the equal of the absolute, for if the absolute is conceived to precede the cause,

and is the cause of the cause, then the cause is controlled, but the cause put as an abstraction for the absolute is the absolute and uncontrolled. The absolute, the infinite, the cause—each can exist as separate conceptions of a definite whole. It is not because the conceptions are several that they are contradictory to the conception that the infinite absolute exists by itself, and afterwards manifests itself as a cause of phenomenal effects; for this, say what may be said, is what the cause amounts to,—in other words, a Creator.

The notion of the infinite becoming what it was not from the first is an arbitrary assumption, because it is impossible for human thought to penetrate the absolute as such, the infinite as such, or the cause as such. Conceive an infinite absolute which is itself the cause of all effects, then we have an absolute comprehending within itself all which the human mind can conceive as attributes, and which constitutes within itself "*the all of all.*" To say the absolute is not absolute because it is infinite, and that the cause is not omnipotent and omniscient because effects proceed from it, is mere idleness; and to say that if omnipotence "is uncaused that there need be no cause for anything" may be logic, but it certainly is not sense. All these confusions arise because the finite intelligence is not equal to an infinite conception. Without analysis we present the synthesis—God. We know things are caused,—Science proves the fact; our perceptions of phenomena apply them as facts; we trace effects to cause, cause to cause, still we cannot get beyond an existence in consciousness. That we cannot conceive how an initiating cause came into being is no proof that it was caused, nor is it any proof that it was uncaused; we only know that a cause exhibited in effects exists, but when we find effects we also find something outside them. Our faculties being finite cannot carry us to the beyond, but it does not follow that there is no beyond. All this is thinkable; we are merely unable to fathom the unfathomable. We see mind, and we are told we know "its beginning in time." This is exactly what we do not know, nor the genesis of substance, nor of force. We may form conceptions of them, and judged by our perceptions both mind and force are uncaused, and we only arrive at some analysis by means of our reason. We conceive mind is not force because mind directs it, and that matter (in its received sense) is not a cause because force impels it. Mind must have preceded force, as force must have preceded substance, and without intelligence there could be no mind; then intelligence must

have preceded mind. To say that intelligence and mind are the same is not true, because intelligence is unparticled; mind is particled into ideas, thoughts, reasons, memories, &c., the whole subsisting as intelligence cognized in consciousness. We cannot reason beyond consciousness, for where perception and conception go consciousness goes with them. If we, possessing a finite consciousness, can conceive so vastly as to magnify the conception by infinitude, we have then the apprehension of a something which the human conception cannot grasp, and is therefore unfathomable as far as we can think. If it be said that consciousness is conditioned, for it is said to be limited, conceive infinitude as one of its aspects, and there is no limitation; and so it is in all the aspects in which it may be contemplated,—call it by whatever name it may be called, we have but that which is perfect in its own perceptions and conceptions, not as parts or conditions or states, but as an abiding whole, a perfected entity; and whether finite or infinite the same principle pervades it. In its infinite aspect it comprehends time and space, and all to which perception and intelligence can attain. There is no need to chop logic in such a conception, for it contains its own logical answer—that which is the whole can only be equal to itself. Extend the human conception so that it shall comprise all possible conceptions, and we have comprised in its cognizance the Absolute, the Infinite, the Cause, an inseparable and an all comprehensive entity manifested in phenomena.

In what way "the fundamental conceptions of rational Theology" are self-destructive, supposing the absolute, &c., are the fundamental conceptions, I am at a loss to conceive; but if an assumption is to be taken for a fact, and we begin by a *given*, then we reason from the assumption, and all the inductions it will fairly carry are admitted with it. But when several things are presented, not as the constituted thing but as conditions of the thing, and taking each as such, then any hypothesis, logical or otherwise, has within itself the potence of its own destruction.

We cannot reason on the absolute supposing it to be an ultimate conception, for when we begin to reason on it it is not then the absolute, but a conception of the finite, as are all suppositions which stretch beyond the bounds of the human mind. We get a conception of the oblate sphere we call the world by balancing facts, by experiment, and by observations upon the sequences and aptitudes of natural things; we go beyond, and find by the consonance of induction that an oblate solid sphere must have existed as an

incandescent mass (?) or as mist : research of Science shows that there are such mists floating in the sky, and that their material has been examined, and by deductions it is concluded that all these mists consist of cosmic materials. We are still in the region of phenomena, and the conception of them is attained by a mental contrasting of minute effects with gigantic ones. The mind through observation discovers an uniformity of action, and for convenience the unity of effects is called law,—a law by which all phenomenal effects are governed, but when the mind extends itself beyond phenomena it reasons only on the conceptions which are the effects of its own presentments, and are judged by rules not drawn from the phenomena, but which are the inventions of itself, and by which it insists that the precession of its conceptions shall be governed. Observations on phenomena have disclosed a law by which they are governed, and we say the law had an institutor because the human faculty is able to frame laws by which it can govern and produce sequences, the outcomes of the law. But the law governing natural phenomena, being no institution of man, by inductive reasoning it is inferred that this phenomenal law had also an institutor with an intelligence and power equal to command the effects produced. Man finds, to institute his law, he must employ his intelligence in order to arrange his sequences and produce a harmonious result: when he arrives at the I think, or thought in the comparison of phenomena, he by induction arrives at an I think, or intelligence commensurate with its production, and as his I think is an individualism, by a parity of reasoning we should say that the I think discovered in phenomena is also an individualism or entity; and as he disinters from phenomenal nature the mystery of a cause not existing in the world of the seen, so he arrives *at* a consciousness comprising within itself an intelligence with the capacity to produce natural phenomena. Beyond the true region of phenomena the human mind does not realise the conceptions which its own ideas have presented, but makes these conceptions subjective, and presents them as objects, but which the mind fails to translate in their facts, and these ideas being insoluble in thought remain as conceptive symbols. The beyond is not unthinkable, but unfathomable.

There are many images presented in the mind, but they are facts only because of their presentment in consciousness, for in consciousness alone is comprised all phenomenal existence, and this phenomenal existence is the range of the human intellect. Within these ranges man frames his own

conceptions, for between the genesis of mind and its ultimate (whatever that may be) there is the most perfect freedom of will.

It is mere fancy to talk of polytheistic, monotheistic, and atheistical faiths, or, as it is put, Atheism, Pantheism, and Theism, in a logical disquisition on mental processes, they being but conceptions framed in thought. With the principles of the mind as to innate perceptions, influx and inspiration, we have not now to do, but which, when phenomenal, are considered as distinctive attributes or conditions. From all that has gone before it follows that each creed and God, be the conceptions what they may, are only phases of thought, and are real so long as they are recognized in consciousness; being so, man is the architect of his own future: to repeat the aphorism of Bishop Clerk, " Where we leave off in this life we begin in the next." Here is the true common ground and meeting point of all creeds, but we have not now to discuss their reasonableness or unreasonableness. We can arrive at " an ultimate religious truth of the highest possible certainty " different to that which Mr. Spencer introduces. " Now every theory asserts two things: *firstly*, there is something to be explained; *secondly*, that such and such is the explanation." Hence, however, widely different speculators may disagree in the solutions they may give of the same problem, " yet by implication they agree there is a problem to be solved." " Here there is an element which all creeds have in common. Religions diametrically opposed in their overt dogmas are yet perfectly at one in the tacit conviction that the existence of the world, with all it contains and all which surrounds it, is a mystery ever preparing for interpretation." This assumption cannot be considered to be an " ultimate religious truth." It has alone a basis as a phenomenal enquiry. Most creeds, if not all, deny there is any mystery to explain, and all dispose of phenomenal enquiries by presenting a cosmic theory, either assumed to be an inspiration of the founder or adopted as being the inspiration of other gifted men. An acquaintance with the history of creeds, and of some philosophies approaching the importance of creeds, points to an ethical axiom, however differently expressed, common to them all. It is found in the Vedas; it was the inculcation of Zoroaster as an article of faith. It was propounded by Confutse. It is found in the Jewish writings, in those of Plato, and in Egyptian mythology. It was the inculcation of Jesus, and occupies a place in the Kuran, varied in phrase, as follows in a true transcript: " Do unto others as you would they should do

unto you." It is the inculcation of the bond of brotherhood, the link-chain of humanity, and may be considered as an ultimate religious truth, a fundamental basis, and "a vital element in all religions."

Mr. Spencer appears to be ignorant of this general moral law, or, if not ignorant, he is open to a graver imputation. He says, after a peculiar kind of reasoning (page 45), "Thus while other constituents of religious creeds drop away, this remains (inscrutableness of creation) and grows even more manifest, and so is shown to be an essential constituent." He ends his exposition by saying "that the power which the Universe manifests is to us inscrutable," which he emphasised in the following observation:—"Instead of disclosing a fundamental verity existing in each, our investigation seems rather to show there is no fundamental verity contained in any."

As far as space would admit a presentment is made of Mr. Spencer's Theology. It must be obvious to all who choose to think, that the mere presentment of Mr. Spencer's propositions, as subjects to reason upon, contain within themselves the negation of the whole of his hypotheses, *viz.*, that they are unthinkable. What process of reasoning can be carried on without thought? To a common apprehension thought, thinking, and thinkable, are very much alike.

Mr. Spencer has a great name, is a great thinker, and a very able man; but it does not follow that the conclusions of great thinkers are always correct or conclusive. At one time he pictures an impossible Utopia (Sociology); at another introduces confusion into subjects which common sense not only readily assents to, but which every experience confirms. Logical disquisitions are useful as mental exercises, and there their uses end. We have then a war of words which each Professor construes in accordance with his own formula, and as a consequence we have a Babel of confusion. Mill has one interpretation, Sir William Hamilton another, Kant another, Hegel another, with Spencer, and a whole host of logical metaphysicians whose names are legion: in this aspect well might Lewes assert that a system of philosophy is impossible. Mr. Spencer is largely quoted by a know-nothing class of would-be philosophers. I have heard Mr. Spencer cited as an authority for the greatest absurdities, and this because he has not been *read*, or, where *picking* has been adopted, the particular selection has not been understood; hence an incredible amount of mischief has resulted. The crudities of these would-be philosophers have been adopted by an audience ignorant as

themselves, not exactly upon the reasons they advance, but upon the authority of a quoted name. Even nonsense ably put is very alluring to a great class of readers; but strong vigorous reasonings, even although the bases be hypothetical or false, are a lure too great to be neglected. Accept Mr. Spencer's teachings *in toto* (as many do, and without the patient examination so necessary to understand his theses), then all which makes the sum of human intelligence and human hope is but a dream, "and leaves not a wreck behind."

II. THE EXTRACTION OF SUGAR FROM THE JUICE OF THE CANE AND THE JUICE OF THE BEET-ROOT, VIEWED IN ITS COMMERCIAL ASPECT.

By Robert Galloway, M.R.I.A.

THE present appears to be a very opportune time for considering the subject which the title of this paper indicates*; for not only have the Technical Commissioners selected the manufacture of beet-root sugar as an example of an important industry benefitting, or rather owing its origin to, the scientific and technical training the industrial community receive in Germany and France; but also the manufacture of beet-root sugar as an industry for England has been strongly recommended very recently by two well-known chemists. By the way I would recommend those who have money to invest not to attach too much importance to the certificates of these gentlemen, as neither of them has had, I believe, any practical experience in the manufacture or refining of sugar, and sound knowledge on

* This article was all but completed before I saw it announced that the "Quarterly Review" for this quarter would contain an article on "The West Indies and Sugar Bounties." I make this remark as it might be thought by some that the title of that article had suggested the subject to me.—R. G.

this, as on other subjects, does not come by inspiration.* Furthermore, according to newspaper statistics, 30,000 work-people have been thrown out of employment in the United Kingdom, owing to the importation into the country of the *bounty-fed* beet-root sugar produced in Germany, France, Belgium, and the Netherlands.

Although I and others may not agree in every particular with the strictures the late Baron Liebig published about thirty years ago, in his well-known work "Familiar Letters on Chemistry," on the system pursued in Germany and other continental countries for fostering the beet-root sugar industry, nevertheless I think that this manufacture is not a felicitous example of the advantages a nation would derive by affording its sons the best opportunities for acquiring a sound and complete course of scientific and technical education. Granted that a great deal of chemical and engineering ingenuity has been expended on the improvement of this industry, it is all but certain that the talent applied to its improvement would have been unfruitful if the industry itself had not been fostered directly or indirectly by State grants. If industries have not only to be started, but have to be perpetually upheld by State bounties, they cannot be regarded as sound commercial industries.† Of what value

* Investors before staking their money in this new industry for England ought to read the letter signed "An Observer," which appeared in the "Times" of May 31st, 1884.

† It is admitted, even by strict political economists like the late John Stuart Mill, that protecting duties are defensible when they are *imposed temporarily* in hopes of neutralising a foreign industry, in itself perfectly suitable to the circumstances of the country; as the superiority of one country over another in a branch of production often arises only from having begun it sooner, the one possessing no advantage over the other except a present superiority of acquired skill and experience. "It is a just remark of Mr. Rae," Mr. Mill observes in his "Principles of Political Economy," "that nothing has a greater tendency to promote improvements in any branch of production than its trial under a new set of conditions. But it cannot be expected that individuals should at their own risk, or rather to their certain loss, introduce a new manufacture, and bear the burden of carrying it on until the producers have been educated up to the level of those with whom the processes are traditional. A protecting duty, continued for a *reasonable time*, will sometimes be the least inconvenient method in which the nation can tax itself for the support of such an experiment. But the protection should be confined to cases in which there is good ground of assurance that the industry which it fosters will after a time be able to dispense with it." I have quoted these observations of the late Mr. Mill, that protecting duties, or the guaranteeing from loss those who start important industries in a country, are defensible for a time on strict political economy principles, as English statesmen of the present day need to be reminded of this national duty. In Ireland, for example, where there exists little manufacturing skill and experience, what more prosperous industry could be started than the manufacture of the different substances—iodine, bromine, and the potash and soda salts—existing in kelp; the raw material, seaweed, abounding in the sea encircling the most poverty-stricken districts of that part of the United Kingdom; but Government aid, in the form of a guarantee against loss, is required to start it.

as a manufacturing process, for example, would the production of alizarin artificially be, if it could not be manufactured artificially at an equal or at a less cost than it cost to cultivate the madder root, and extract the colour, as had hitherto been done, from that root. The beauty of the method for artificially obtaining this colour would not be in the least affected by the result, and the discovery would still remain as beneficial to pure Science; but as a manufacturing process it would have to be said that it had failed, if its manufacture did not fulfil one of the conditions named.

Liebig remarks, in the work I have referred to, that "the financial laws of Continental States have selected sugar as an article *to be taxed on importation;* and the Government of the States forming the German Customs Union received, as duty on 1,200,000 cwts. of sugar imported in 1846, £875,000, which made part of the sum required for the expenditure of these States. In the same year ninety-six manufacturers of beet-root sugar in the Union produced 334,320 cwts. of sugar from 4,446,469 cwts. of beet-root, and this sugar was consumed within the Union at the same price as the sugar imported from tropical countries. Had this beet-root sugar not been produced at home an equal weight of sugar would have been imported. In that case the State would have received 2,400,000 florins (£120,000), at the rate of 8¾ florins per cwt., which sum was paid to the manufacturers of beet-root sugar in the price of the sugar. Instead, therefore, of about 13 millions of florins, which the State would then have received, it received only 10½ millions; and it is plain that without the deficit of about 2½ millions other taxes might have been diminished to that extent. The inhabitants of the Union, therefore, paid 2½ millions of florins to the beet-root sugar manufacturers, and 2½ millions in other taxes. Each of the ninety-six manufacturers received, on an average, about 25,000 florins (£2000) from the population, without the latter having derived any advantage whatever from the payment. *The satisfaction of eating sugar grown on our own soil is therefore purchased at a not inconsiderable sacrifice.*"

Before entering upon the question whether the manufacture of sugar from beet-root could have arisen—and if it had whether it would not have been confined to a very small area—if the manufacture of sugar from the cane had been carried on under as favourable conditions for the manufacture of that sugar as the manufacturers of beet-root sugar have enjoyed, independent altogether of the advantages they have derived from the bounty system, we will notice a few passages

in the Report of the Select Committee on Sugar Industries, ordered by the House of Commons *to be* printed, 4th August, 1880; the Committee having been appointed to inquire into the effects produced upon the Home and Colonial Sugar Industries of this country by the systems of taxation, drawbacks, and bounties on the exportation of sugar, now in force in different foreign countries.

The Committee stated that loaf-sugar refining was formerly a considerable industry in this country, there having been in the year 1864 about thirty loaf-sugar refineries, converting, in round numbers, 200,000 tons of raw into 140,000 tons of loaf sugar per annum, and employing £600,000 floating and £600,000 dead capital, in addition to the capital employed in other trades connected with the business. From that year there was a gradual decline in the trade, until in 1875 it became practically extinct. With the decline in the manufacture in this country there has been a continuous increase in the importation of loaf sugar from foreign countries. In 1863 the import amounted to 13,731 tons, of which 5285 tons came from France and 5960 from Holland; in 1871 the import had grown to 78,551 tons, of which 37,000 tons came from France and 27,500 tons from Holland; and in 1878 the import had grown to 157,807 tons, of which 115,683 tons came from France and 32,500 tons from Holland. This decline in our own country, and the extension in other countries, of the production of loaf sugar did not arise from the want of enterprise or skill on the part of our refiners, or to any natural disadvantages they laboured under; but the extinction of the manufacture in England, and its extension in foreign countries, was due to the fact that the foreign refiner was enabled to put his sugar on the English market below cost price, owing to the bounty his Government gave him on the sugar he exported; and of course against such competition the English refiner was unable to contend successfully.

At the time the Committee reported, no refined moist sugar, which had become an important branch of refining in England, was manufactured on the Continent; but they observe that if the system of bounties on export was extended to moist sugar, the ruin which had befallen the loaf-sugar refiners would likewise happen to the refiners of moist sugar.

I understand that no *refined* moist sugar is ever now imported into the United Kingdom from the Continental States; but whilst France has been lowering its bounties, the bounties in Germany, Austria, and Holland have been

increased to such an extent, both on refined sugar (loaf) and brown moist sugar, that it has become unremunerative not alone for our refiners at home to manufacture loaf sugar, but it is likewise unremunerative for our colonial sugar manufacturers to sell their unrefined moist sugar in the English market.

France is now suffering almost as much as England, owing to the large bounties the Governments of Germany, Austria, and Holland are giving their manufacturers: it is thought by those well conversant with the subject that, if these excessive bounties continue, France will have to meet the competition by returning again to the excessive bounty system.

I therefore repeat that I am of opinion that this industry is not a felicitous example of the benefits a nation ought to derive by affording its industrial community the means of obtaining a sound scientific and technical education. For whilst the continental sugar manufacturer can by the bounty system place his sugar on the English market below cost price, he sells at home his sugar at nearly, if not quite, double the price he supplies it at to the English consumers.

After we have inquired to some extent into the effects of the bounty system on the Colonial Sugar Industry, I will subsequently propose a scheme which, if adopted in our sugar-producing colonies, would enable the manufacturer to contend far more successfully with the continental ones; and it might thus be the means of destroying the bounty system.

Mr. Neville Lubbock, one of the witnesses examined before the Committee, estimated the total value of the estates in the West Indies at £12,700,000, irrespective of town property dependent on sugar interests. The value of the estates in the Mauritius he calculated at £6,000,000, and in India at £1,000,000. If to these sums is added the value of the town property, and the property not sugar estates, but which is dependent for its value on the sugar industry, it would raise, he considered, the amount of capital involved in this industry in the British possessions to fully £30,000,000. The number of people employed in the industry he estimated at 250,000, and the amount of wages annually paid them at £6,000,000.

In 1879 it was asserted that the prices obtainable for raw cane sugar did not pay for the cost of cultivation, except on estates very favourably situated: this year, 1884, matters are still worse, for although in Barbadoes there is a good crop, 18*s*. per cwt. (the present price) would not nearly pay

the planter; he could not produce the sugar for that sum; and matters are said to be still worse in Demerara and Trinidad.

A general abandonment of sugar cultivation must therefore take place in these colonies if the present prices for cane sugar continue to last much longer, and if no remedy can be devised. And it is upon the success of the sugar industry that our West India colonies mainly depend, both for the employment of their population and the collection of their revenue. In 1879 the abandonment of estates had begun; in Jamaica alone, in that year, thirty-six estates were advertised for sale without finding buyers, and one estate—for which £12,000 had been offered a short time before—was then being abandoned.*

I have already stated that the beet-root sugar manufacturer extracts his sugar under more favourable conditions than the cane sugar manufacturer has hitherto possessed; the advantages I alluded to do not include the bounty system, but are what may be termed local and natural advantages: they were pretty fully described by Liebig, *viz.*, superior processes employed in the manufacture, a climate more advantageous for the working up of the juice, and more intelligence engaged in directing the operations. These advantages, with the exception of climate, need not, as I shall show, continue; and the advantages of climate may be greatly minimised.

The advantages the cane sugar manufacturer possesses over the beet-root sugar manufacturer are much more *important*, for he operates upon a juice much richer in sugar and containing a much less quantity of impurities, as will be seen by the following analyses. The analyses must of course be viewed as only approximative, but that will not materially alter the relative proportions both of the sugar and the impurities.

Peligot found the juice of the Otaheite cane from Martinique contained the following percentage of the different substances named:—

* Superadded to the disadvantages our colonial planters experience in the English markets, they now experience very similar disadvantages in the markets of the United States, for Spain can now introduce the sugar manufactured in her plantations into the United States on better terms than can be obtained for the sugar manufactured in our own colonies: she has procured from the United States the most favoured-nation treaty for her colonies, including slave-growing Cuba, whilst our Foreign Secretary, Lord Granville, states that it is impossible for Great Britain to obtain like treatment for Her Majesty's West India colonies.

Water	79·60
Sugar	20·00
Other vegetable matters	0·20
Inorganic matter (ash)	0·21
	100·01

Weight of solid matters, 20·41.

The following analysis of beet-juice is extracted from Spon's "Encyclopædia of the Industrial Arts and Manufactures":—

Water	86·612
Sugar	11·250
Other vegetable matters	1·467
Inorganic matter (ash)	0·671
	100·000

Weight of solid matters, 13·388.

These analyses show us that for every 100 tons of sugar in 400 tons of the juice of the cane, there are only 52 tons of sugar in the same quantity (400 tons) in the juice of the beet-root: this of course is a very serious difference; but this difference is greatly enhanced when the amount of sugar produced on an acre of land by growing the cane, and on an acre of land by growing beet, and the relative value of the land in the West Indies and on the Continent are taken into account. At the time when Liebig wrote, 10 cwts. of sugar on an average existed in the beet-root grown on an acre of the best land in Germany, whilst the amount of sugar existing in the sugar-cane grown on an acre of land in the West Indies amounted to from 40 to 50 cwts., whilst the rent of the land in the West Indies was only one-tenth of what it was on the Continent: these proportions may have somewhat altered since that time, but a very wide margin still remains in favour of the sugar-cane. Then again the analyses show us that for every 100 of sugar in the juice of the cane there is present along with it only 1·00 of vegetable and 1·05 of inorganic impurities, whereas along with every 100 of sugar in the juice of the beet there exists 13·04 of vegetable and 5·96 of inorganic impurities. And if it were not for the presence of the vegetable impurities *white* sugar would be obtained *direct* from the juice without the juice having to undergo any purification, as it would be absolutely free from all organic impurities, and, furthermore,

owing to their absence it would not ferment. The inorganic impurities also act injuriously, as they prevent a certain amount of sugar from crystallising out; and the larger the quantity of these impurities, the larger the quantity of the sugar kept in solution.

The kind of vegetable impurities present in the juice of the beet are not only more detrimental in the manufacture of the sugar than those existing in the cane by reason of their greater *quantity*, but they are also more detrimental by reason of their *quality;* for if the same simple and imperfect purification were adopted for purifying the juice of the beet as has been employed for purifying the juice of the cane, the sugar produced would be unsaleable except for refining purposes, and even for these purposes it would command, comparatively with cane sugar, but a small price; and the relative quantities of sugar capable of being obtained by this mode of clarifying the juice would be very much less in the case of the beet than would be obtainable from the juice of the cane, and, further, the molasses from the beet-juice would be unsaleable, except for the purpose of being manufactured by the process of fermentation into *raw* spirit. And the advantages rest with the cane with respect to the quantities of the vegetable impurities; for although I am not going to advocate or recommend the purification of cane-juice by means of charcoal, as I believe it can be purified *more perfectly* by a much cheaper and more speedy method; nevertheless if the juice of the cane and that of the beet were purified by charcoal under the *same conditions*, a much larger quantity would not only be required to purify a quantity of beet-juice containing, say, 100 tons of sugar, than it would to purify to an equal extent a quantity of cane-juice containing the same amount of sugar, but the charcoal employed in purifying the beet-juice would also become much sooner exhausted than it would in purifying the juice of the cane, because the animal charcoal would become sooner coated with *vegetable* carbon in the former than in the latter case, and, as is well known, vegetable charcoal is very inferior, in decolorising and in other absorbing powers, to animal charcoal.

It appears almost an opprobrium to chemical science that no manufacturing process for *perfectly*, *speedily*, and *cheaply* removing the 0·20 per cent of vegetable impurities in the cane-juice has been discovered, as the result would be so important, *viz.*, *white* sugar direct from the juice, with an increase at least of 50 per cent in the quantity of sugar obtained from a given quantity of juice.

With regard to the nature of these impurities, books treating on the manufacture and refining of sugar are very misty and misleading on this most important point. In studying them one would naturally infer that these impurities were of the same class, and without variation in their relative quantities in the juice of the canes grown in different localities: if this were the case, then the rum obtained on fermenting the molasses would have the same aroma and flavour wherever the cane was grown; yet it is well known in the commercial world this is not the case. The aroma and flavour of Jamaica rum, for example, are very different to the aroma and flavour of the rum made in Barbadoes.

When out in the West Indies, some years ago, I made an examination of these impurities in the juice of canes grown in Demerara, Barbadoes, Trinidad, St. Kitts, &c.* I found these vegetable impurities are composed of several different classes of substances, and possessing of course different properties, and therefore no one purifying agent will remove all the classes. I also found that some of the classes are almost entirely absent in the juice of the canes grown in one locality, whilst they largely predominate in the juice of canes grown in another locality. This variation in the quantity of the classes of impurities in the juice of canes grown in different localities goes far to explain the very different opinions that have been expressed by manufacturers, in different sugar countries, on different manufacturing processes that have been tried from time to time, whether in the form of purifying agents or machinery.

Some years before visiting the West Indies a Brazilian nobleman informed me that neither the Brazilian Government nor private owners could make their sugar estates pay, and he stated it was their intention to establish a central factory, to which the canes from the different estates would be sent for the extraction and manufacture of the sugar. The Brazilian Government shortly afterwards offered me, through this nobleman, the entire management of the factory; but although I considered the plan an excellent one, and the terms offered me were all that I could desire, as my terms would be their terms, I declined the offer for reasons I need not enter into. This led me, however, on my visit to the West Indies, to carefully investigate the manufacture of sugar from the cane in this as well as in other aspects; and I came to the conclusion that for any

* I had not an opportunity of examining the juice of the canes grown in Jamaica, which I greatly regretted.

real improvement to take place the planter or grower of the cane must cease to be the manufacturer of the sugar, for as long as the occupier of each estate manufactures his own sugar, as is done at present, only imperfect processes for the manufacture can be adopted, for each grower would not have the means for employing the intelligence and skill that would be required for carrying out a process by means of which *white* sugar would be obtained as readily as *brown* sugar is at present produced, and with the large increase I have already named in the quantity of sugar. It would be more reasonable for every farmer to be a butcher, a miller, and even a baker, than for the grower of sugar-canes to manufacture the sugar from the canes he grows, as in the former businesses little (if any) scientific skill is required for their superintendence after they are once started, whereas with regard to the manufacture of sugar scientific knowledge and skill are constantly required: this is proved by the fact that in the former trades little is left to be done in the way of improvements, whereas in the manufacture of sugar from the cane the most vital improvement has yet to be achieved.

But the advantages that would accrue from the separation of the purely agricultural from the manufacturing operations in the case of the sugar industry has only, in the present day, to be stated for it to be seen and comprehended; for it is now admitted that the production of butter and cheese can in most cases be more satisfactorily, in every respect, carried on by specialists than by the farmers. And a perfect process for the manufacture of sugar, like all other perfect processes, would necessarily require more skill, care, and attention than a crude and imperfect one requires.

The possibility of not only obtaining *white* sugar in small quantities or under exceptional circumstances, but in large quantities and under the ordinary natural conditions, cannot be gainsaid, for the refiner accomplishes it with sugar containing, in addition to the impurities of the juice, those which have been formed by the unskilful treatment the sugar underwent in the process of manufacture. That it can be obtained *white* cheaply and readily I have convinced myself, as I have ascertained that the vegetable impurities in the juice can be completely removed; and if this perfect defecation of the juice were accomplished a system of evaporation could be employed in which the natural heat of the climate could be utilised, which cannot be done with an impure juice.

Were this most vital improvement carried out in the manufacture of cane sugar, the beet-root sugar industry

would be nearly, if not altogether, extinguished, as no bounties the Continental Governments could afford to give their sugar manufacturers would enable them to compete with the manufacturers of cane sugar under these greatly improved conditions.

III. INSECT PREFERENCES.

By J. W. Slater.

IT is generally considered, and not by any means without grounds, that the Hymenoptera are of all insects the most cleanly in their persons and their habits. The social species,—especially ants, hive-bees, and wasps,—among other proofs of civilisation manifest some regard to sanitary regulations. The Texas agricultural ant, according to Dr. McCook, summarily expels any dung-beetle which presumes to roll its ball of ordure upon the sacred pavement around its nest. Ants remove the bodies of their dead outside the camp, and have even been known to give them formal burial. Wasps have been admired for their skill in snatching away flies from any offensive substance without soiling their own feet. Nevertheless facts may be observed proving that these industrious and quick-tempered insects are not more consistent in their cleanliness than are mankind. Civilised man preys on "high" game, on the "trail" of the snipe, on sour-krout, and, what is infinitely worse, on "eingelegte Bohnen"—*anglicè*, putrescent kidney beans. Surely, then, we may be tolerant if we find a wasp guilty of cannibalism, or of any other indelicacy.

Walking lately around a pond near Aylesbury, for the purpose of observing the doings of the water insects, I saw lying on the bank a dead perch, which might weigh about a pound. The fish was in a very offensive state, and over it hovered with querulous buzzings a flock of blowflies. Wondering why they did not settle upon the perch and "blow" it, I looked more particularly, and saw that a party of wasps were in possession. They ran up and down upon the carcase, nibbling choice fragments about the gills, and tasting the juices. Hence the blowflies naturally kept aloof, fearing lest they might be seized and dismembered. Hence it

appears that wasps as well as flies are unclean feeders, and that they may deposit upon our food or our persons putrefactive ferments, or possibly disease germs.

As to bees and butterflies, their preferences for certain flowers have already been made the subject of not a few interesting observations; but we are as yet far removed from being able to reduce their predilections, either for odours or colours, to any definite principle.

It is certain that, as far as the scents of plants are concerned, insect likings are not as human likings. Of this I have just had some very striking instances. Opposite the window of the room where I am writing these lines stand a number of privet-bushes in full bloom. The air is full of their odour, which near at hand is very peculiar and scarcely describable, whilst at a greater distance it has a sugary, but somewhat sickly, character. Neither near nor far, however, does it strike my scent-nerves agreeably, and a number of persons whom I have asked all agree that they could not regard it as a perfume. Yet these privet-blossoms are at this moment simply crowded with hive-bees, wild bees of various sorts, large and small "cabbage-whites," painted ladies, small tortoiseshells without end, and a few large ones. By way of contrast, among the privets stands a Syringa in full blossom; but its flowers, so much more pleasant to human organs, have scarcely a winged visitor, or if by chance a bee or a butterfly strays over it is evidently a mistake, and the insect loses no time in getting back to the privet flowers.

To take a similar case: at a little distance off is a patch of prickly comfrey, full of flowers. The smell of this plant when handled is positively offensive. The flowers have a dull, herbaceous odour, slightly blended with a sugary sickliness; but the whole patch is perfectly alive with bees. It would be easy to net half a dozen at a single stroke of an insect-net. The colour of the flowers is also not very striking—a dull, washed-out, reddish violet.

Another plant much haunted by insects, but more by butterflies than by bees, is the so-called African *Sedum*. Its odour is not very enticing, is of the sugary class, and its colour is a reduced impure red,—such a colour, in fact, as might be produced by setting a very awkward apprentice to dye a grain crimson upon dirty woollen cloth, and giving him very inferior materials. There is scarcely any plant which more deserves cultivation by lovers of moths and butterflies in country, or even suburban, districts. Sweet marjoram, another plant which much resembles the African

Sedum in the dull, impoverished crimson of its blossom, is greatly beloved by butterflies, less so by bees. Its odour has the same sugary character, blended with a shade of aromatic pungency.

Now if we compare with the plants above mentioned some of those possessing odours the most agreeable to man,—such as the clove-pink, the carnation, especially the lavender,—we find them relatively neglected by insects.

We may, indeed, form a notion of the kind of odours dear to insects from the mixtures used by lepidopterists in "sugaring" for moths. Coarse sugars, treacle, mixed with stale beer, rum, &c., attract not moths alone, but bees, wasps, flies, and even some Coleoptera.

There is not a predilection, but an aversion of certain insects which is somewhat peculiar. Everyone who takes a walk in the fields and woods in warm, still, summer weather must have noticed the flies which hover round him, and constantly strive to settle upon his eyes or intrude into the nostrils. These evil beings, whose chief mission seems to be the utter refutation of optimism, have a strange aversion to bricks and mortar, even in homœopathic doses. The other day I walked along an open country road, persecuted by these obtrusive wretches. At last the road became the wide, straggling street of a small country town, bordered by cottages standing in groups of two and three together, and separated from each other by gardens, orchards, and paddocks. Here the flies almost at once ceased to be a nuisance.

On another occasion I had been taking a stroll among the Chiltern Hills, and was there so buzzed about and crawled on that observation became well-nigh impossible. Yet on my approaching the village of Little Kimble the annoyance came to an end. I was particularly struck with this whilst waiting on the platform at the railway-station. On the other side of the line—a single one, moreover—there was nothing but open fields and hedgerow trees. Why should the flies be so much less troublesome here than at the distance of a quarter of a mile, where there was similar scenery on both sides of the road? I have repeatedly noticed similar phenomena, but I am at a loss for the explanation. If man is the appointed prey of these tiny harpies, why do they not follow him into the towns where he is more plentiful? If trees and bushes and fields are necessary for their comfort, why do they disappear when these still form at least nine-tenths of the landscape? Lastly, it must be noticed that hundreds of thousands of

such flies must live and die without ever having partaken of human blood, or of human secretions whatsoever. Why, then, are they so persistently eager for what is not necessary to their existence, and what, in many cases, they and their forefathers have never tasted?

If, as is now generally admitted, these beings are moreover the pedlers of disease, can the teleologist pronounce their existence, if purposive, as other than malignantly so? And if they have arisen without purpose, on the principle of Natural Selection, the difficulties of the case are not smaller.

IV. THE ADAPTIVE RANGE OF THE BATRACHIANS, AND THE CORRELATION OF ORGANS.

By Dr. J. Kollmann.

THE power of adaptation to different surrounding circumstances is strikingly developed in the Batrachians. According to established facts the range within which their organism can accommodate itself to novel relations is more extended than that of any other vertebrate animal, and its limits are by no means ascertained. As the most striking example may be mentioned the results of Miss von Chauvin, who by artificial means kept back four axolotls for three years in an intermediate stage, in which the nature of the water-newts and that of the Amblystomas are so blended that the animals can live either in or out of water. The newt, formerly regarded as perennibranchial, as the most recent intelligence from South America shows, can after the lapse of a year become terrestrial, as soon as circumstances demand. But it may be retained in an intermediate stage of development, and its organism can exist as the *Siredon.* Yet more; its organism can rise to the highest stage of its capacity for development, become terrestrial, throw off its gills, evolve lungs, and become adapted for life on the dry land. Still, if desirable, it can lay aside its terrestrial costume just completed, and resume its fish-nature. After the

lapse of three years Miss von Chauvin induced two specimens to return to their original element, and by the application of suitable means they again become complete axolotls.

Dr. J. Kollmann has seen such animals which have thus repeatedly passed through the most extreme range of a vertebrate organism. He shows also (in the "Zoologischen Anzeiger") that European Batrachians also possess an extraordinary range of adaptability. It has been long ago observed that their larvæ hybernate as such, and then reach a very considerable magnitude. Prof. Pfluger has observed them hybernating at Bonn and Prague; others give an account of the hybernation of Tritons and of certain Anoura, such as *Rana esculenta* and *Alytes*. Kollmann has himself met with hybernating larvæ of *Rana esculenta* and *Pelobates fuscus*, which retained their perfect larval character. Hence it follows that, under certain conditions acting on the organism of these European larvæ, their transformation into the terrestrial form of the animal does not take place.

Not less strange is it that these creatures do not at once escape from their imprisonment in the water as soon as opportunity offers. Instead of climbing on the land at the first approach of spring, they prefer a longer sojourn in the water. Their nature seems no longer desirous of becoming terrestrial; they hold fast their youthful form—a phenomenon which Kollman has named "Neotenism." This fact is connected with the developmental phenomena of the axolotl. This animal in Mexico very often declines to assume its land-guise, and it passes years, or even its entire life, in the form of a perennibranchiate. The remaining of a so highly developed vertebrate on a lower ontogenetic stage of evolution is a fact perfectly new to Biology, and is not less interesting than the extraordinary degree of adaptability among the Batrachians.

In a memoir by Signor Camerano, recently published in the "Transactions of the Academy of Turin," on the neotenism of the Amphibia, the author points out that *Triton alpestris* is particularly distinguished by the frequency with which it appears in the neotenic condition. According to a recent investigation not fewer than fifteen species of European Anoura may remain in the larval form longer than has been supposed. This is especially the case with *Rana muta*. The animals remain either entirely or partially in their aquatic stage. The organism can even carry certain of its youthful features over into its land-life. An entire

series of the most various combinations have been traced which may occur in these species. Sometimes the intestines, the lungs, or the gills, or only the general form of the body or the skin retains the transitory ontogenetic character.

Further investigations must show in how far the law of correlation can be set aside, for in this respect also the Batrachians promise to be of a prominent importance.

In connection with the above-mentioned facts it must be discussed what organs in the Batrachians have the strongest influence upon correlation. We might *à priori* feel disposed to assume that the sexual organs, as determining the perpetuance of the species, would play the most important part. This, however, at least as far as the Urodela are concerned, is by no means the case. Their sexual glands come to maturity, the semen is evacuated, the ova are fertilised, so that new generations appear,—*e.g.*, in the axolotl,—and still the entire body retains its youthful formation. The sexual organs do not seem so intimately connected with the individual life of the animal that their development involves correlative phenomena in the remaining organs.

With the organs of respiration the case is quite different. Not the development of the lungs *per se*, but their full physiological function, involves the most far-reaching changes in the entire organism. The hybernating Anoura, in spite of their fish form and their branchial respiration, have lungs which contain air; they, therefore, doubtless inhale air from time to time. But these lungs are but small, and do not suffice for respiration; their reduced form is not capable of exerting a profound influence upon the remaining organs. The skull, the vertebræ, and the intestinal canal remain in an embryonic condition, corresponding to the gills which perform the physiological duty of respiratory organs. The entire body, muscles and bones, and the circulation remain on the same ontogenetic stage of development as the gills—that is, they remain embryonic. All this is changed at once as soon as the lungs come fully into play. In this respect the above-mentioned experiments of Miss von Chauvin are so exceedingly instructive, because they show most clearly how profound is the influence of the respiratory organs upon the correlative transformation of other parts of the organism.

V. ON TROPICAL EPIPHYTES.

THE aspect of a tropical primæval forest is essentially determined by the luxuriant growth of cpiphytic, or, as they are more popularly styled, parasitic plants. Their countless forms cover the tops of the trees in strange profusion, and give them that fascinating variety which delights the traveller. These plants are not in all cases to be regarded as true parasites: their roots do not penetrate into the interior of the tissues of the trees on which they dwell. On the contrary, they creep along the surface of the bark or enter chinks which already exist. Like the lichens of the North they are content with the nourishment to be met with on the surface of their host, or are even totally independent of it as far as nutrition is concerned. They are led to this peculiar way of life by the struggle for light so predominant among forest vegetation. They utilise the stems of trees merely as stages or supports in order to reach the light.

Several interesting questions here at once suggest themselves. How, for instance, do these plants continue to exist amidst unfavourable conditions? How do they, growing on a hard, smooth bark, obtain the needful supply of water and of inorganic food? These questions have been thoroughly discussed by A. F. W. Schimper, in a treatise published in the "Botan. Central-Blatt," and in the "Naturforscher." This author's studies relate chiefly to the Epiphytes of the West Indies, and are mainly founded on observations which he made in 1883, in Dominica and Trinidad. The gorgeous vegetation of this latter island will doubtless be known to many of our readers—if from no other source—from the eloquent descriptions of the late Charles Kingsley.

In the epiphytic flora of the West Indies the greatest number of species belong to the Orchids, though the Bromeliaceæ and the Aroids surpass them in the number of individual plants and in their conspicuous character. The ferns are especially rich both in individuals and in species.

As the dwellers on trees are exposed to the same unfavourable conditions as ground plants in a very dry soil, they are provided, like the latter, with succulent or leathery leaves, which exhale moisture very sparingly, and do not readily wither. The stems sometimes form rosette-like tuberous swellings, and send out roots many and strong, which creep or climb on the supporting tree and produce numerous

secondary roots. The seeds are adapted for distribution by the wind or by animals; some of them are arranged for what may be called flight; others are exceptionally light; and others, again, are enclosed in juicy fruits. In many Epiphytes we meet, besides, with a non-sexual reproduction by means of stolons, or shoots, which subsequently become independent, and which in some cases, as in *Tillandsia usneoides*, entirely supersede sexual reproduction.

The Epiphytes, as regards their manner of life, may be divided into four groups. The first class comprises those plants which for their whole lifetime obtain their nutriment solely from the surface of the bark to which they have become attached. The second and third classes are thus dependent on their support in their youth only, and the fourth never. These plants procure a more plentiful supply of nourishment, either by aërial roots which they send down into the soil (second group); or by roots which form an extended tissue, of a sponge-like character, in which moisture and humus accumulate in abundance (third group); or, lastly, the leaves and stems perform the function, generally peculiar to roots, *i.e.*, the intus-susception of food (fourth group).

In the first group, on the lowest stage of adaptation to an epiphytic life, we find forms which, like ground-plants, take up their nourishment by means of capillary roots. Many such species live, therefore, exclusively on the bark of very old trees, rich in nutritious matter and full of chinks. Some occur only in very moist forests. To this group there belong certain Polypodiums (some of the European representatives of which genus are well known as growing on the stems of decaying trees), *Peperomia*, *Columnea*, *Rhipsalis*, *&c.*

Better adapted are the orchids and aroids. Their roots are fitted with a peculiar coating, capable of absorbing water, and technically known as the velamen. This covering is partially lost only in an advanced age. Here, as in the former group, the roots penetrate into the fissures and hollows of the bark. They contain a little chlorophyll, but their power of assimilating carbon is feeble, as they are enclosed in the velamen and are negatively heliotropic, turning away from the light.

In the leafless short-stemmed *Aeranthes funalis* the roots, which form the main bulk of the plant, perform all the functions of vegetation. These roots are green, and hang for the most part freely in the air. In accordance with the slight development of leaf and stem, and the reduced transpiration, the vascular bundle of the roots is thin and contains

but few vessels. The green of the surface is interrupted by white stripes which mark out parts of small permeability for water, but great permeability for gases, and seem to replace the apertures of ordinary assimilating organs.

In the second group, where the roots subsequently always reach the ground, the great expenditure of material does not correspond to the object gained, as the connection of such Epiphytes with the soil is but imperfect. In some cases, however, a step is taken to perfect development; the two functions of nutrition and fixation are allotted to different roots. The clinging roots, destined to secure the plant in its place, are strongly negatively heliotropic, but are not notably affected by gravitation. They grow slowly, seldom reaching the length of two feet, and die off like tendrils if they do not soon meet with a support. As soon as such a one is found they creep along it or twine around it. The vascular bundle consists of lignified thick-sided fibres. The nutritive roots are often negatively heliotropic, and are always under the influence of gravitation, being strongly attracted to the earth. They grow rapidly to an unlimited length. In a short time they can reach the soil from a height of 100 feet, and there they ramify abundantly. The vascular bundle consists of tracheæ with a wide opening and of sieve-tubes, whilst the mechanical elements are less important.

The same two classes of roots may likewise be distinguished in the Epiphytes of the third group, though the differentiation of the two classes is here less decided. The clinging roots are negatively heliotropic, and possess a great tensile power. The nutrient roots are chiefly concerned with the utilisation of nutriment situate *above* the isodiametric system of roots. They are therefore positively heliotropic, and are directed upwards. But contact occasions many changes in the direction of their growth, as well as anastomoses, forming an inextricable network. Anatomically speaking, the two classes of roots differ little. The nutritive roots absorb nourishment, and the cling-roots transmit it to the shoots. In *Anthurium Hugelii* the root system, more than a cubic foot in bulk, surrounds and overtops the short stem, and sends numerous ramifications into the humous mass of decaying vegetable matter which accumulates among the crown of leaves.

In the fourth group the roots disappear altogether, or are reduced to mere organs of adhesion. Here we find only the Bromeliaceæ. The simplest arrangement occurs in *Tillandsia usneoides.* This plant, entirely rootless, hangs down from the branches of trees in bundles resembling the tails of

horses, and two to three yards in length. These consist of thread-like shoots, coiled spirally, withered at their base, and arising from a single twig. Such a one, torn from its seat by the wind or by birds, twines round the branch of a tree, and sends out shoots freely suspended in the air. The plant propagates itself only in this asexual manner, whilst most other Bromeliaceæ produce numerous seeds, which readily germinate on the rind of trees. The plant is covered with scale-like hairs, through which liquids can very readily penetrate into its tissues, whilst the rest of the epidermis is relatively impermeable. The spoon-shaped bases of the leaves always contain water and putrescent organic matters which—as it has been experimentally proved—are not merely utilised by the plant, but are necessary to its existence.

The leaves of *Tillandsia bulbosa* appear admirably adapted to its peculiar conditions of existence. The leaf-sheath forms here a bulb-like organ, always containing water and dead insects. As it closes nearly air-tight the water is not lost even in an inverted position. The plant is therefore in no need of negative geotrupism. The water penetrates into the cavity by capillary attraction. The interior of the leaves is lined with numerous absorbent scales.

Dr. Schimper appends a sketch of the connection between the vital relations and the geographical distribution of the Epiphytes.

The essential conditions of a luxuriant growth of epiphytic plants are light and moisture. It is therefore most splendidly developed in narrow clearings in the mountain forests and on the banks of woodland streams. The epiphytic vegetation of dry localities—the "Savanna flora" according to Schimper—is characterised by the predominance of scaly Bromeliaceæ, which therefore appear white or grey. In the primæval forests there are more Bromeliaceæ with tender leaves. In more open parts of the woods there occur representatives of the Savanna flora. On the other hand, we find on trees in the Savannas not seldom forest Epiphytes, though for the most part smaller and less luxuriant. In artificial clearings in the drier parts of the woods we may observe how the forest Epiphytes gradually give place to the Savanna forms. The latter have probably been developed out of emigrants from the primæval forests. Otherwise we must assume a very recent immigration of the former, since within historical times the West Indian Islands were wooded down to the water's edge.

The texture of the bark of their host has also an influence upon the physiognomy of the epiphytic flora. A bark full of

fissures forms a more suitable substratum than a smooth one. The most easily contented plants in this respect are the Bromeliaceæ, which flourish even on the smoothest barks, and thus serve as pioneers for other plants. Their root-bodies are often quite covered with other Epiphytes.

Many Epiphytes are limited to some particular trees; for example, *Trichomanes sinuosum* to tree-ferns. *Aspidium sesquipedale* and *A. nodosum* occur in Trinidad only on palm-trees at the base of whose leaf-stems they find a sufficiently rich and moist substratum of humus, which might not be easily found elsewhere in the relatively dry climate of this island. In other countries they are less restricted in their station.

If the foliage of a tree is too dense the development of epiphytic vegetation is prevented, as light and rain do not find sufficient admission. Thus the mango tree, whose dark crown is shunned even by birds, is almost entirely free from Epiphytes.

The disappearance of this class of plants on the seashore is probably due to the salt present in the atmosphere.

Notwithstanding numerous cases of exclusive adaptation, the general resemblance of the epiphytic flora to that which in tropical regions covers rocks and stony ground cannot be overlooked. Bromeliaceæ, Cactaceæ and ferns are very common both on trees and rocks, though the species are not identical. But the rock flora is the poorer on account of the less favourable substratum, in which deep fissures are wanting, the absence of dew, and the less advantageous illumination, which is either direct sunlight or deep shade.

VI. ON THE CONSTITUTION OF GASEOUS HEAVENLY BODIES.

PROF. A. RITTER has been engaged with certain investigations relating to the period of development of the fixed stars, the colour of the twin stars, the entire duration of the visible existence of the fixed stars, and the present condition of Sirius. He remarks, in the "Naturforscher," that the whole duration of the visible existence of a fixed star is divided into three periods of

unequal length by the culminating point of its heat-radiation (or the epoch of its greatest brightness) and the culminating point of its eradiation temperature, or that epoch in which the colour of its light approaches most nearly to the blue extremity of the spectrum.

During the first period the eradiation of heat was continually on the increase. At the beginning of this period, when the star is still in the condition of a nebulous spot, this change of state takes place very slowly, since at that time the emission of heat was very small. Subsequently it is much accelerated, when by increasing density the eradiation of heat reaches its culminating point.

During the second period the eradiation of heat is already decreasing, whilst the temperature of radiation is still on the increase. The speed of the change of condition is at first great, and becomes subsequently gradually less when the temperature of eradiation reaches its maximum value.

During the third period both the heat-radiation and the temperature of eradiation are constantly diminishing, and during this entire period the change is very slow.

With reference to the second stage of development, the author has shown elsewhere that the relative speeds of the changes of condition of two fixed stars are as their masses. The duration of the transition of a fixed star from the culminating point of the heat-radiation to the culminating point of the temperature of eradiation is approximately inversely as its mass.

The culminating point of the temperature of eradiation forms the beginning of the period of cooling, and the duration of the latter will be in any case the longer, the greater the mass of the star. For the duration of cooling of the sun, or the assumption that its contraction will proceed at least until its density is everywhere as great as the present density at the centre of the earth, and supposing an equable decrease both of the surface-temperature and of the surface itself, we obtain as inferior limit a time of about 76 million years, and we may assume that during the greater part of this period of refrigeration—therefore at least during the next 40 million years—the sun will continue to send out luminous heat-rays.

The duration of the change of the sun from the culminating point of its heat-radiation to the culminating point of the temperature of eradiation amounted, on the other hand, to about 4 million years only. For a fixed star whose mass is greater than the mass of the sun there will be a greater distance between these two epochs, and as, further,

only fixed stars of great mass ever reach that temperature which corresponds to the emission of a bluish white light, there results the following proposition :—

The duration of the transition from a reddish to a bluish light is always very small in comparison to the duration of the subsequent return from a bluish to a reddish light.

If therefore we have two fixed stars, A and B, which simultaneously reach the culminating point of their heat-radiation, A possessing a relatively large and B a relatively small mass, A will at first outstrip B in its development, and reach the culminating point of its temperature of eradiation earlier than B. Subsequently it will again lose the advance which it had gained. During the very protracted period of cooling-down A will again be overtaken by B in the process of refrigeration, so that B will reach the end of this period earlier than A. As A has a higher temperature of eradiation than B, and not only attains this temperature earlier than B, but retains it longer, A will at all times have a higher temperature of eradiation than B.

If therefore two such stars, which simultaneously reached the culminating point of their heat-radiation, are, for the sake of brevity, designated as "coeval" stars, we arrive at the following proposition :—

Of two coeval stars, the one whose light approaches in colour nearest to the red extremity of the spectrum has the smaller mass.

If both stars have a relatively low age and are at equal distances from the earth, the red star, in spite of its smaller mass, may appear as the brighter of the two, inasmuch as it is not yet as far removed from the culminating point of its heat-eradiation, or brightness,—and inversely, from the greater brightness of the redder star we may infer the comparatively low age of both. As in double stars the brighter of the two is generally designated as the principal, the following proposition would follow on the supposition of the equal age of both :—

If the colour of the principal star lies nearer the red extremity of the prism than that of its companion, the principal is the one possesing the smaller mass, and both stars are still—if we may use the expression—in a relatively youthful stage.

During the contraction of a gaseous cosmic body the parts belonging to the superficial stratum approach the centre; and as the speed of this subsidence can never exceed the speed of a freely falling body, we may deduce an inferior limit for the duration of the nebular spot period

from the assumption that the subsidence of the superficial layer during this period has always taken place with the speed of a freely falling body. In this manner we find, as an inferior limit to the time which the sun's radius would have required in decreasing from an initial value equal to about half the distance of the nearest fixed star down to the magnitude of the radius of the orbit of Neptune, or to the radius of the earth's orbit (the latter assumption giving a result which differs from the former merely in a vanishing degree), a time of about 16 million years.

As the inferior limit of the whole duration of existence of a fixed star of the mass of the sun, we should find a time of about 60 million years, of which 16 million years belong to the nebular period, 4 millions to the transition from the culminating point of the heat-radiation to the culminating point of the temperature of eradiation, and 40 million years to that part of the process of refrigeration which corresponds to the emission of light. The real duration of the phenomenon may be considerably greater, as in the above estimate the continuous increase of mass and heat determined by the fall of meteorites has been ignored.

[It will at once strike the reader that this estimate does not agree with an earlier passage in this memoir, where the life of our sun to the end of its luminosity, and apparently without including the nebular portion of its career, is taken at 76 million years. Geologists and biologists will require much more positive evidence than astronomers and physicists have yet furnished before accepting such low estimates for the age of the sun, and consequently of the earth.]

As a confirmation of the theory here put forward may perhaps be noticed the change in the colour of Sirius which has occurred within historical times. That this star was decidedly red 2000 years ago can scarcely be doubted after the accordant evidence of Ptolemy, Cicero, Horace, and Seneca. Seneca remarks expressly that the light of Sirius was more decidedly red than that of Mars. As Sirius now appears of a bluish white it would have to be assumed, according to the author's theory, that about 2000 years ago Sirius was still in the first stage of development of red light, and that its temperature of eradiation has considerably increased in the meantime.

On the assumption of a certain mean consistence of the gas of which our Sun consists, by applying the above method of investigation we should arrive at the result that its radius has required 28,150 years in decreasing from 100 times to 20 times its present magnitude, and that during this time

the temperature of eradiation has risen from 21·5 to 36·8 per cent of its present value.

As the mass of Sirius is 13·8 times that of the Sun, Sirius must have passed through the same period of development in 2040 years, and during this lapse of time its temperature of eradiation must increase from 80 to 137 per cent of that temperature. If we therefore assume that the radius of Sirius is twenty times greater than it would be in the present state of density of the Sun, or that the present mean density of Sirius is the 8000th part of the mean density of the Sun, it would follow that the eradiation temperature of Sirius 2040 years ago was 20 per cent smaller, and is now 37 per cent greater, than the present temperature of eradiation of the sun. As the light of the sun is at present yellowish white, it is very easily conceivable that a temperature of eradiation 20 per cent lower might correspond to a reddish colour, and one 37 per cent higher to a blueish white.

According to this hypothesis the diameter of Sirius must at present amount to 9 million miles, giving, at an assumed distance of 20 billion miles, an apparent diameter of 0·09 second. It would follow also from the hypothesis that the temperature of Sirius is still increasing, and has only reached about 36·8 per cent of its maximum value. Hence the blue colour of the light of Sirius may considerably increase in the future.

VII. THE GEOLOGICAL STRUCTURE OF THE SAHARA.

DR. K. A. ZITTEL has published the following facts and conclusions as the preliminary result of his explorations in the Libyan Desert:—

The Sahara is distinguished by an exceedingly simple geological structure, by the horizontal position of most of its sedimentary rocks, and by the absence of faults. To the southern slope of the Atlas in Morocco, which forms the northern boundary of the Sahara, there are joined palæozoic formations (carboniferous and Devonian), upon

which follow, further to the south, sandstones, palæozoic slates, sometimes interpenetrated by granite and porphyry, as also quartzite and azoïc clay-slate.

In the depression between the Atlas and the Ahaggar Mountains middle and upper cretaceous rocks form the substratum, whilst quaternary sandy fresh-water clays, with gypsum and rock-salt, constitute the superficial layers. The same cretaceous deposits form the soil of the Hammada el Homra, and of the Harudj Mountains in Tripoli. In the south it is directly followed by Devonian sandstone. The latter, with the underlying limestones and slates, is the predominant formation to the southern limit of the Desert.

Permian, triassic, jurassic, and subcretaceous formations have been hitherto detected neither in the Sahara nor the Egyptian frontier mountains. The great plateau-mountains of Ahaggar in Air and Tibetsi seem principally to consist of palæozoic sandstone, clay-slate, gneiss, granite, and recent eruptive volcanic rocks. Tertiary deposits of marine origin are to be found only to the north of the Chotts of Tunis. They occur also to a considerable extent in the Libyan and Arabian Deserts. In the north-eastern Sahara and in Egypt the eocene nummulitic rocks extend southwards to the latitude of Esneh: the miocene rocks have their southern limit at the oasis of Sinah, and the hills between Cairo and Suez.

The southern and a part of the central Sahara have been dry land since the end of the Devonian period; the greater part of the remaining Sahara was left dry after the cretaceous epoch. The sea still maintained itself in the Libyan Desert during the eocene, and in the northern part of that region down to the middle miocene.

The eruptions of the basaltic, phonolithic, and trachytic rocks in Tripoli, the Libyan and Arabian Deserts, as also probably those in the mountain-lands of Ahaggar and Tubu, occasioned but little disturbance in the adjacent formations, and must have ensued chiefly in the later tertiary times.

During the diluvial period the Sahara, as well as a part of the southern and eastern Mediterranean, was dry land. The hypothesis of a diluvial Sahara sea is confirmed neither by the geological structure nor the surface appearance of the Desert. At the utmost the region of the Tunisian Chotts may have been connected with the Mediterranean, and perhaps the narrow depression between Alexandria and the Ammon oasis with the Red Sea.

During the Diluvial period there prevailed in North Africa

a moist climate, which probably continued until the beginning of the present epoch.

The characteristic formation of the surface of the Desert, the elaboration of many dry valleys, the formation of basin-shaped depressions, the origin of steep banks, insulated mountains, &c., are due to the erosive action of fresh water.

The sand of the Desert has been produced by the decomposition of sandstone, which predominates everywhere in the middle and southern Sahara. Its distribution and accumulation in dunes has been effected by the wind.

The salt-marshes, and the saline and gypsiferous superficial deposits, have been formed by the evaporation of waters which had collected in the hollows. There is no proof of any essential change in the climate of the Sahara during the historical period.

ANALYSES OF BOOKS.

Terminal Forms of Life. By Professor JOHN CLELAND, M.D., LL.D., F.R.S.

THE substance of the pamphlet before us has been delivered as a Lecture in St. Andrew's Hall, Glasgow, and has been reproduced in the "Journal of Anatomy and Physiology." Though extending but to 17 pages it is, we do not hesitate to say, one of the most serious critiques on that phase of Evolutionism known as Darwinism—that is, the theory of the development of animal forms by "accumulated chance variations"—which have ever appeared. Prof. Cleland argues that on this supposition "all the lines of development of forms will necessarily be indefinite; that in them all, change, progressive as well as other, will be occurring at the present time, very slowly, but as much as ever it did, and that it must continue to occur." In opposition to this view he seeks to show "that the animal kingdom is full of forms which when once reached (whether through uninterrupted lines of descent from a common ancestry or not) have no power to advance further." Such are what the author names terminal forms. As instances of such forms he mentions, firstly, the lamp-shells. One genus of these, the *Lingula*, is traced in one of the oldest fossiliferous rocks, and still exists at the present time without essential change. More complex lamp-shells, such as the *Spirifer* and the *Productus*, may also be traced back to the Old Red Sandstone. "Since that time," continues Dr. Cleland, "so ineffective have their accidental variations been in the struggle for existence that by far the greater number have become extinct, while they have left no other kind of animal behind them that by any possibility could be supposed to have had them among its ancestors."

As another case we find mention of the ordinary bivalves, such as the cockle, oyster, mussel, and scallop. They have indeed attained their maximum development at the present day, but "they have flourished from far-off Silurian times, and palæontologists describe from the Silurian rocks numerous species resembling pearl-oysters, cockles, and mussels. There is no reason to imagine that any of them have become ancestors during all the time since then of animals other than bivalves."

As a more striking example may be taken the cuttle-fishes:— "Notwithstanding the high complexity of these animals compared with other invertebrates, their ancestors have not been

occupied by any means up to the present time fighting their way up to that position, and so left us to believe that the present forms may in time become in turn the ancestors of creatures wholly different. On the contrary, allies of the nautilus are recognised in the Silurian rocks, while remains of an extinct description of cuttle-fishes, called Belemnites, declare that at a time considerably before the chalk cliffs of England had begun to be deposited at the bottom of a long bygone sea, the remarkable anatomy of the cuttle-fish was already exemplified in a completeness which has indeed been varied, but not essentially deviated from since."

Dr. Cleland next contends that it was from no modification of the arthropods—crustaceans and insects—that vertebrate animals arose. This proposition we suspect no one will venture to dispute. It is indeed strange why the terrestrial arthropods should be so limited in size. There is, indeed, a fossil orthopterous insect which with outspread wings must have measured nearly a yard across. But we doubt if in these days there exists an insect of double the bulk and weight of (*e.g.*) *Goliathus Drurei.* This, however, is a digression.

After mentioning a number of other instances the author writes :—" But man is a terminus, and not only *a* terminus, but *the* terminus of the advance of vertebrate life." He considers that the development of the vertebrate form has reached its limit of completion in man. He holds it " in the last degree improbable that in the future there will be a progression in the construction of the human body that will give birth to greater intelligences than the heroes and sages of antiquity. "

Our readers, even from this slight sketch, will doubtless conclude that Dr. Cleland's pamphlet, brief as it is, deserves a most careful consideration, and that its arguments cannot be overlooked or hastily set aside. For that certain animal forms have not advanced, but remain down to our days substantially what their ancestors were untold æons ago, is simply a fact ; but it is still open to doubt whether this fact or complex of facts necessitates the interpretation which Prof. Cleland puts upon it.

In endeavouring to reply to him we must first quote his concluding passage :—" To me the animal kingdom appears not an indefinite growth like a tree, but a temple with many minarets, none of them capable of being prolonged,—while the central dome is completed by the structure of man. The development of the animal kingdom is the development of intelligence chained to matter ; the animals in which the nervous system has reached the greatest perfection are the vertebrates ; and in man that part of the nervous system which is the organ of intelligence reaches, as I have sought to show, the highest development possible to a vertebrate animal, while intelligence itself has grown to reflection and volition. On these grounds I believe, not that man is the highest form of intelligence, but that the human body is the highest form of animal life possible subject to the conditions of

matter on the surface of the globe, and that its structure completes the design of the animal kingdom."

But does the animal kingdom resemble a temple rather than a tree? Dr. Cleland has shown that some of its forms are terminal, but the words here used "none of them capable of being prolonged," have no warrant in what has gone before. The assertion may be true, but it is, to say the least, unproven.

Again (and this is a striking difference from a temple), many of the lines of advance in the organic world have not merely been brought to a close; they have, so to speak, been demolished. Not merely species and genera, but entire groups of higher rank have disappeared. This agrees ill with the idea of a well-planned temple; but it is exactly what we see in the "indefinite growth" of a tree. Not merely leaves fall, but certain twigs, and even branches of great size, have withered and fallen, or exhibit merely their dead remains, while the tree still lives on. A tree, we know, may even change its "leader." What was at one time the topmost branch may be arrested in its growth, and may either perish or be overtopped by others. This, surely, is what has repeatedly taken place in the history of the animal kingdom,—a fact sometimes conveyed in the so-called "doctrine of the unspecialised."

We may compare the animal world to a tree, not young and rapidly growing, but old, containing much dead wood and many branches that hinder each other, and might be profitably cut out, —containing also many branches which, if alive and still putting forth leaves, have ceased to grow. In Sherwood Forest the reader may see not a few such trees.

Man is by no means universally recognised by modern biologists as the crown and apex of the animal world. Prof. Minot, of Harvard University, read, before the Cincinnati meeting of the American Association for the Advancement of Science, a paper bearing the title "Is man the highest animal?" and answered his own question in the negative. Prof. Mivart, too, pronounces the cats to be "the very flower and culmination of the Mammalian animal tree, and adds that man, "considered merely in his capacity as an animal [whatever these words may mean] has a very definite place in such a scheme, but it is by no means certain that his place is at its summit." Prof. Minot further adds that "it is very doubtful whether mammals would be regarded as the highest class of the animal kingdom were they not our nearest relatives." We do not, indeed, accept these views, and we are even of opinion that Prof. Minot has been completely refuted in the "Journal of Science" for 1881 (p. 661). But they at least show that certain points upon which Dr. Cleland's argument partially turns are still matter of question.

We must further remember that, as shown by Dr. Clevenger, the adaptation of man to the upright position is not absolutely perfect, so that there is still room for improvement. Whether

we are travelling in that direction is a different question. We are certainly not authorised to speak on behalf of orthodox Darwinists; but we doubt whether any of them would admit that all animal species are necessarily moving upwards. Some of them are retrograding; some of them, even on the supposition that the development of species takes place "mainly through the transmission to posterity of accumulated chance variations," may remain stationary. We do not know, with any approach to certainty or completeness, all the conditions under which variation occurs. Further, *ex hypothesi*, those variations only will be preserved which are beneficial to the animal. It may well be that the "terminal forms" enumerated by Dr. Cleland may be such in which the vital conditions are hostile to variation. It may indeed be—though the idea approaches the position of Prof. Cleland more nearly than that of Darwin—that the capacity of variation in any animal line is not infinite.

We are very far, however, from supposing that these considerations are sufficient to dispose of the author's contention. The subject is one requiring a much more profound examination than it can here receive. Dr. Cleland, indeed, deserves the gratitude of biologists for having raised this interesting question.

Text-Book of Descriptive Mineralogy. By HILARY BAUERMANN, F.G.S. London: Longmans and Co.

WE have here a compact and clear manual of the descriptive portion of mineralogy. The illustrations are excellent in their class, being a reproduction of those used in the work of Brooke and Miller.

In the introductory chapter we find some remarks on mineralogical nomenclature, a department of the science which has not yet reached perfection. The names of minerals are not in all cases cosmopolitan. Thus, to take instances here quoted, the substance known in England and Germany as Leucite is called Amphigene by French and Italian mineralogists, whilst "Idocrase, used in France and England, is equivalent to the German Vesuvian."

The sources of names are extremely variable. We have some derived from the writings of Pliny and Theophrastus, others from the German metallurgists of the fifteenth and sixteenth centuries. Complimentary names, first originated by Werner, have multiplied exceedingly, and however objectionable in some respects, have at least the advantage of brevity. Local names, the author justly remarks, may be either good or bad. Thus, when a very widely-distributed mineral is called from some one

spot where, amongst others, it may be found the principle is faulty. Or, again, it is objectionable if the name of a considerable district rich in mineral species is given to some one of its products; such name should as early as possible be superseded.

The author's classification in the main agrees with that of Rammelsberg, as given in the second edition of his "Mineral-Chemie." The arrangement of Mohs and Breithaupt with a binary nomenclature like that prevalent in zoology and botany he considers impracticable, "the objection of requiring two special names to indicate a mineral instead of one being sufficient to condemn it for ordinary use." Here, perhaps, there may be room for a difference of opinion. We scarcely see how the combination of a generic and specific name should be more inconvenient in one science than in another. However, the introduction of the binomial system in mineralogy would now occasion so much trouble and confusion that it cannot be seriously advocated.

The author's families of minerals are the native elements, the arsenides, and antimonides, the sulphides; the sulpho-salts; oxides; silicates, hydro-silicates; titanates, niobates and their analogues, the tungstates, molybdates, and chromates; sulphates, phosphates, arseniates, and vanadiates; borates; carbonates and nitrates; haloid salts; and, lastly, the minerals of organic origin.

The descriptions of the several mineral species may be pronounced accurate, though in a volume not extending to quite 400 pages elaborate detail has not been practicable.

Report of the Commissioner of Agriculture for the Year 1883. Washington: Government Printing Office.

THIS report contains very much interesting matter. The Veterinarian gives an account of several epizootics which are causing serious losses to farmers. Foremost stands the so-called Texan cattle-fever, which is spreading much farther to the north than it was till lately supposed possible. The frosts and snows of severe winters are unable to put an end to the infection. The disease is not identical with anthrax, and the well-known *Bacillus anthracis* is absent in the cattle attacked. The author, however, considers that the diplococcus of the spleen is the true germ of the disease, and suggests that it may be converted into a vaccine. The following observations merit close investigation:—"It is difficult to understand in the present condition of Science how it is possible for the native cattle of a section permanently infected with a contagious plague to resist the influences of the contagion by which they are surrounded; it is equally difficult to understand how apparently healthy cattle can distribute this

contagion for so long a time after they leave the infected district; and it surely is not less difficult to understand why the cattle really sick of this contagious disease do not convey the contagion to others."

The next subject is poultry-cholera, which has been submitted to experimental investigation. It appears that the immunity gained by inoculation is retained in most cases during the entire lifetime of a fowl. Contrary, however, to what seemed at one time probable, the offspring of insusceptible fowls does not possess any special immunity. The importance of this disease may be judged from the fact that the losses which it occasions certainly do not fall short of ten millions dollars annually!

Certain recent results on the comparative efficacy of disinfectants are quoted, from which it appears that mercuric chloride (corrosive sublimate) is *facile princeps*.

Among the diseases of sheep must be mentioned that produced by the "screw-worm," the lava of a *Lucilia*, which sometimes oviposits in the nostrils of persons sleeping in the open air, with even fatal results.

The total loss in the United States from the diseases of domestic animals is fearful to consider. Perhaps the knowledge of this loss, and of the necessity of studying all branches of the subject thoroughly, renders the practical American public less susceptible than that of Britain to that epidemic lunacy known as Anti-vivisectionism!

In the botanical report some interesting matter is brought forward. There appears in the West to prevail the notion that wheat, in unfavourable seasons, will turn to "cheat" (*Bromus secalinus*), and that a head of wheat and another of cheat may even grow upon the same stalk. The report is illustrated with twenty-five well-executed plates representing different grasses.

From the report of the Entomologist we learn that our common "cabbage white" (*Pieris rapæ*), though only introduced into the western hemisphere about 1856, has already spread from Canada to the Gulf of Mexico, and proves more destructive than any American *Pieris*.

Pieris monuste, another cabbage destroyer which occupies the more southern States and spreads to the West Indies, Guiana, and Brazil, sometimes travels in swarms of many thousands, keeping at about 15 to 20 feet from the earth. They are, notwithstanding, shy and difficult to capture.

P. oleacea, a native of the more northern parts of the States, is noted for its pugnacity. Sometimes a group of a dozen will engage in a "free fight" with such eagerness that a bird or a dragon-fly approaches unobserved and makes havoc among the combatants.

The remedies against insect pests require much further study. Some species resist pyrethrum, quassia, nitrate of soda, turpentine, carbolic soap, coal oil, salt, lime, red pepper, Scotch snuff,

&c. Paris green (copper arsenite) and London purple (an arsenical residue from the manufacture of magenta) are effectual, but they are too dangerous to sprinkle over cabbages.

If we take this section in connection with that on epizootics due to minute living organisms, it must strike the most careless observer to what an extent the supply of human food, and hence the possible quantity of human life is limited by minute animals and plants. We cannot help thinking that the war against "poverty" can be more successfully waged by the biologist and the chemist than by socialistic agitators.

Bulletin of the Philosophical Society of Washington. Vol. VI. Containing the Minutes of the Society for the Year 1883, and the Minutes of the Mathematical Section from its Organisation, March 29th, to the close of the year. Published by the Co-operation of the Smithsonian Institution. Washington: 1884.

Among the most noteworthy papers here included is one by Mr. F. A. King on "The Prevention of Malarial Diseases, illustrating the Conservative Function of Ague." The author contends—and with a great show of probability—that the principal facts concerning the occurrence of marsh-fevers are best explained by the theory that these diseases are due to the bites of mosquitoes and other man-haunting suctorial insects. That the Diptera are the great *colporteurs* of infectious disease has been our opinion for thirty years, and until lately it has been simply—very simply—derided. Now the tide is turning. There are, however, some points on which we cannot, all at once, agree with Mr. King. He considers that the dark hue of the negro's skin is protective:—"The negro is protected from the *sight*, and consequently from the *bite*, of the mosquito; a similar protection being further secured by the offensive odour and greasiness of his cutaneous secretions, aided by artificial inunction of the body with grease, paint, and pitch." He considers malarial melanosis to be the "designed natural termination of ague,—its conservative function—destined to modify the individual by defensive adaptation against the mosquito."

We do not know in how far the negro may escape the sight of mosquitoes rather than does the Aryan. Nor can we say which of the two is most agreeable to mosquito olfactories. But we find something strange in the author's reasoning. Ague is produced by mosquito bites, and its ultimate result is to render man less susceptible to such bites! Surely, if Nature's object had been the protection of man, it might have been reached by a simpler and more effective process. We would also ask how it is that mosquitoes are prevalent in Lapland, the north coast of

Siberia, and other regions where malaria is unknown? We admit, however, that dirty people are less generally attacked by bugs, fleas, &c., than such as are thoroughly clean. We know, also, on unquestionable authority that tropical districts free from malaria are free from mosquitoes. A friend of ours, who spent some years on the West Coast of Africa, found that protection from mosquitoes meant practically protection from fever.

Mr. G. K. Gilbert, in a paper on the "Response of Terrestrial Climate to Secular Variations in Solar Radiation," sustains in a quantitative discussion, the proposition that an increase of solar radiation does not augment but diminishes glaciation. Such rise, though it increases total precipitation, diminishes snow-fall, and very greatly increases the rate of melting.

Mr. J. W. Chickering read a most interesting paper on the "Thermal Belts of North Carolina." The general opinion is that in one and the same district the temperature decreases gradually and regularly with increasing altitude. The late S. McDowell, of Franklin, Macon County, North Carolina, a diligent observer in botany and geology, states that in the valley of the Little Tennesee River, lying about 2000 feet above the sea-level, when the thermometer in the morning indicates a temperature of about 26° F. the frost line extends about 300 feet in vertical height, but then comes a belt extending about 400 feet in vertical height upon the mountain side within which no frost is seen, delicate plants remaining untouched. Above this the frost reappears. Mr. McDowell thinks that such belts exist in all countries traversed by high mountains and deep valleys.

Another such belt has been traced for eight miles along the Tryon mountain-range in North Carolina, extending between the altitudes of 1200 and 2200 feet. Within this belt vegetation remains untouched by frost until the latter part of December, and snow does not lie within the belt when the country both above and below is covered.

Mr. E. J. Farquhar, in a paper on "Dreams in their Relation with Psychology," discussed several theories of dreams, and found none of them quite satisfactory. He dissented from the opinion that the dream-state is devoid of originating power. He considered that all the aspects of the mind were capable of displaying themselves in dreams—judgment and moral sense less than others. This he explains on the principle that conservation and the struggle for existence apply among the mental faculties. Hence the true character of the mind may be seen more clearly by means of dreams than when awake.

Mr. W. B. Taylor, in a memoir on the "Rings of Saturn," maintained that all the planets, without exception, have lost a very large amount of rotatory energy, which may be chiefly ascribed to the retarding effects of internal friction from solar tides.

Mr. A. G. Bell gave a very interesting communication on

"Fallacies concerning the Deaf, and the Influence of such Fallacies in Preventing the Amelioration of their Condition." He exposes, in good truth, a number of very inveterate errors, some of which are of much wider import than the education of deaf-mutes.

There is in the first place the superstition—for it is nothing better—that a majority of persons born deaf are dumb also because of defective vocal organs.

Another absurd notion is that persons born deaf are idiots. It is true that all deaf children are dumb, and it may be true that most—Mr. Bell says all—idiots are dumb. But this is far from justifying the conclusion that all deaf children are idiots. A further mistake, rarely perhaps formally asserted, concerns the nature of language itself. "To unreflecting minds it appears that we grow into speech; that speech is a natural product of the vocal organs." Lastly, comes the crowning error, still hugged by those who strive to uphold the doctrine of a "great gulf" between man and the lower animals. "Without speech no reason," was said by non-observers, and, in spite of facts, it is asserted still by some who might know better.

A Short Text-Book of Inorganic Chemistry. By Dr. HERMANN KOLBE, Professor of Chemistry in the University of Leipzig. Translated and Edited by T. S. HUMPIDGE, Ph.D., B.Sc., Professor of Chemistry and Physics in the University College of Wales. London: Longmans and Co.

IN general terms text-books of chemistry, inorganic or organic, have multiplied to such an extent as to become almost a nuisance. For at least five out of every six it would be difficult to show any good reason why they should ever have come into existence. The present volume, however, constitutes a decided exception. Professor Kolbe as a chemist takes a well-marked, and, we fear. somewhat exceptional position. He is the great opponent of paper chemistry—of sensational formulæ worked out upon a black-board without a solidly-demonstrated basis of facts to support them. He insists upon clearness of thought and language. As a critic he is simply dreaded. He does not fear to rebuke the most admired writers when he finds them indulging in vague expressions and in dreamy hypotheses. The quantity of such defective matter which he has pointed out in the memoirs and treatises of some of the first chemists of the day is a very serious consideration. It would seem as if men of science were giving too free rein to their imagination, and growing impatient of the sober, steady methods of inductive research.

Hence an English version of Prof. Kolbe's Text-book may justly claim a hearty welcome. The preface alone is worth notice as authoritatively enforcing truths too much overlooked both by teachers and students. He writes:—"The chemist has to learn, not by reading, nor by hearing alone, but both by hearing and seeing. A person who has not *seen* the phenomena produced by the union of oxygen and hydrogen, for example, can have no clear conception of them nor of the chemical change which they involve. Nothing is more foolish than the opinion, which I have often heard from young medical students, that chemistry can be studied from books alone. . . . The science is learnt in the laboratory, not in the lecture-theatre. The most that can be done in lectures is to prepare the student for successful work in the laboratory. . . . The problem of the lecturer on chemistry is to give his hearers an idea of chemical processes and the most important chemical theories without burdening their memories with a large number of mere facts, and thus to prepare them to acquire an accurate knowledge of chemistry *by their own practical work.*"

We must beg to call for a moment attention to the last five words. In them lies, we submit, the key to the unquestionable superiority of the German system of higher education to that which we still cling to in England. The English student "reads" for a degree, for honours. The German student "works" or "investigates." Hence the German achieves greatness in virtue of his training, whilst the Englishman, if he rises to eminence, does it in spite of his training.

It need scarcely be said that in the original text of Prof. Kolbe's work there is no reference to any examinations or "syllabus." Here, however, the editor steps in, remarking that "in adapting the book for English students certain alterations and additions were necessary." *Eheu!*

The Round Table Series. (III.) JOHN RUSKIN, Economist. Edinburgh: William Brown.

WE have here a pamphlet which will amply repay thoughtful perusal, and which indeed ought to be studied by every man and woman of culture. The author (Mr. Patrick Geddes), whose name appears not on the title page but at the end of his treatise, is not a mere *litterateur*, but a man who has been trained to scientific research, and has proved himself therein no mean proficient.

We may be asked what assistance an aptitude for or a proficiency in scientific investigation can give to any man in the appreciation of John Ruskin? Is he not a Bestiarian and an opponent of Evolution? Has he not blasphemed entomology,

and indeed all the branches of biology which deal with the tinier forms of animal life? Does he not confound together, under one common anathema, science and what is commonly called "applied science," making the former responsible, as an accomplice before the fact, for all the sins of the latter? Lastly, though not least, is he not prone to imagine moral causes for physical effects?

All this Mr. Geddes does not seek to deny. But he discusses Mr. Ruskin in his character as an economist, or rather as an assailant of the orthodoxies of "poleetical" economy. He refers here to the highly strained relations between "the economists on the one hand and the cultivators of the preliminary sciences on the other." This state of things is shown "not merely by the almost complete suspension of relations between the two camps, or by the fact that only here and there a scientific society accepts economic communications, but also by the frequent occurrence of positive battle." The author speaks of the proposal first formerly made in 1876, to cut off the Economic Section (of the British Association) root and branch, as no better than a disgrace to a scientific association." This proposal we have supported, and continue to support in the belief that this section offers a *nidus* for the bacilli of political agitation, which, in the interests alike of abstract research and of practical invention, we would treat with the most active germicide.

But we can raise a further question: Are political economy and sociology two synonymes? We say, no! Political economy, as far as we understand, views man merely as a producer, accumulator, and consumer of "wealth," all his other functions being substantially ignored.

Now to proceed thus is, we admit, perfectly legitimate as a scientific artifice for convenience of study. To take an illustration: Suppose that nothing definite were known concerning human anatomy and physiology, it would be quite justifiable if a number of men fell to work to study the respiratory organs and their special function, ignoring all the rest of the system. By so doing they would doubtless make more rapid progress than if they had plunged at once into the study of the whole man. But if they assumed that this limited knowledge was human physiology they would be under a grievous error. Worse still if they undertook to practise medicine in the sole light of their results, it would be the vilest and most dangerous quackery, far worse than the empirical routine of their predecessors.

Now this is just what the Economists have been doing. They have taken their shred of a science for sociology, and they have sought to find within it a hygeiene for the body politic.

Now Mr. Ruskin and Mr. Geddes see the short-comings and miserable deficiencies of the economic view. According to it "value does not reside in commodities themselves, and is no more to be found in a loaf of bread than in a diamond, in water, or in air."

Mr. Geddes writes:—"But the economist, continuing to explain that things have no other value, *i.e.*, that phenomena have no other aspect, merely expresses the indisputable fact that they have no other aspect for him; that the question of what loaf and diamond may mean to physicist and physiologist has not occurred to him. . . Let us walk out into the world, look about, try to express loaf and diamond in terms of actual fact, and we find that physical and physiological properties or 'values' can indeed be indefinitely assigned: the one is so much fuel, its heat-giving power measurable in calorimeter, or in actual units of work, the other a definite sensory stimulus, varying according to Fechner's law."

In much the same spirit Mr. Ruskin very justly says:—"Intrinsic value is the absolute power of anything to support life. A sheaf of wheat, of given quality and weight, has in it a measurable power of sustaining the substance of the body; a cubic foot of pure air, a fixed power of sustaining its warmth; and a cluster of flowers of given beauty, a fixed power of enlivening or animating the senses and heart."

In this same connection we find another passage, which we must quote in illustration of those views of Ruskin which the author is advocating:—

"It is among the chief claims to honourable memory of the late Stanley Jevons that he called attention to the wasting coal-supplies of Britain, and demanded their economisation, thus gripping the essential fact that our coal is not merely an object of subjective value and therefore exchange, but the fixture and embodiment of a definite quantity of stored energy, within which our modern industrial activities find a stern and calculable limit. The question of coal-economy is then not in any wise the maximising of the wealth of individual coal-masters or coal-percentagers, as Mr. Ricardo would have explained, neither the increasing of miners' wages, as their official economists would say, but in the relation of actual supply to existing and future demand. In detailed criticism of the nature and purposes of such demand, and the taking definite action against that waste (of 99 per cent or so) in diffused heat and still better diffused soot, amid which the economist of market place and academe complacently preaches '*laissez-faire*' and Mr. Ruskin the reverse."

True, indeed, but the teachings of Mr. Stanley Jevons, though their intent was doubtless as Mr. Geddes here contends, wrought little save evil. They were laid hold of as no unimportant factor in the production of the fearful coal famine of 1872-73, all the consequences of which are not yet at an end. The orthodox economist would say bitter words and urge the doing of bitterer things against a robber-knight—could one exist in our happy days, who should build his castle by the Thames or the Great Northern Railway, and extort heavy toll on all commodities

passing. But when a "ring" interposes between producer and consumer in a more sneaking but even more effectual manner, he persuades himself and tries to persuade others that the public are benefited!

Many persons who read the pamphlet before us will learn with surprise—in this case a wholesome emotion—that "supply and demand," wealth, utility, capital, and labour, all the words, in short, which the economists spell with initial capitals, are mere anti-scientific figments, like the "dormitiveness" of opium talked of by Moliére's physician. They will learn, also, what they ought to have known before, that to maximise production is not the ultimate end and aim of a rational community. They will find that Ruskin, in the true spirit of the Evolutionist philosophy, whose letter he often decries, denounces the modern falsehood of the equality of all men. He endorses Stuart Mill's "terrible dictum that it is doubtful whether the use of machinery has yet lightened the day's toil of a single human being."

Mr. Geddes writes, too truthfully:—"A modern city, however stupendous its wealth—on paper—has after all hardly any ultimate products to show save a sorry aggregate of ill-constructed houses, mean without and unhealthy within, and containing but little of permanent value; for the rest hideous dirt and darkness, smoke and sewage everywhere (which Boards of Works, Metropolitan and other, *will* not purify), as if its inhabitants had absolutely framed an ideal of a short life and a dismal one, with which they are dull enough to rest content." It will be found, in short, on a careful perusal of this pamphlet, especially if read in connection with Mr. Ruskin's own later works, that he is no mad enthusiast, no dreamer, but "the highest practical exponent of Darwin!"

Our space is drawing to a close, but we must quote the author's remarks on education, with almost every word of which we heartily agree:—"For two distinct tendencies are at work in our modern universities and schools, the dominant one deliberately preferring memory of mere words to observation of facts and reasoning therefrom, which should be supplied by *discipline* in science, and more memory of words for that co-ordination of hand and eye which is supplied by practice in the arts, and substituting verbal test of competitive examination for practical test in life. One is the school of Cram, evolving towards a Chinese; the other the school of Culture, evolving towards a Greek (præ-Socratic) ideal, or more accurately towards Tartarean and Olympian ideals respectively."

He who thinks and writes thus is a man after our own heart.

CORRESPONDENCE.

*** The Editor does not hold himself responsible for statements of facts or opinions expressed in Correspondence, or in Articles bearing the signature of their respective authors.

HYLO-IDEALISM.

Constance Arden seems to be very angry upon the comments which have appeared in the "Journal of Science" upon the pamphlet by C. N., of which she avows herself to be the authoress. Being so, I must say that C. N. has not done justice to Constance Arden. C. N. is a poor reasoner, judging by the work, but Constance Arden can defend herself. I never could suppose that C. N. and Constance Arden were of the same sex, but now the authorship is avowed I can discern it in the peculiarity of the marshallings of the subject. F. P. L. appears to have had a juster conception of the capabilities of womankind, and read the riddle. Women may "stoop to conquer." Was this Constance's idea? An article in the "Journal," a critique on Dr. Huxley's automatum, I read, and thought was written in a pleasing, argumentative style: however much I dissented from the hypothesis to which she gave her support, I must confess I did not catch the connecting-link, and the more especially when Constance Arden animadverts upon the criticism on Captain McTaggart's Hylo-Idealism, wherein she avows its Materialism or Monism! Nor could I conceive that the philosophising of Constance Arden could have condescended to the bald hypotheses of C. N.

I do not know whether the lady intends the first three lines of her correspondence in the August number of the "Journal" for me, but I do not feel guilty of gross "misconceptions" or "abusive language." She should remember my remarks were wholly directed to the matter in question,—*i.e.*, to the treatise, and not to the author, and had I known the author to be a woman I might have modified the disgust which her treatment of the subject excited in me. Hypotheses driven about in every direction: now Theologies; now Mr. Bradlaugh; now the French Revolution, with its Dynamics and Atheism—all hashed together and presented as hypotheses in proof. The wantings or excellences of one or all of them appear to me nothing to do with a question which should be purely philosophical.

The Hylo-Idealistic theory, could it even be made clear in its proofs as the light of day, would never answer the needs of a civilised, or of even a savage, community. The whole system would be regulated by the rule of thumb; those who were strongest and most rapacious would take all. There have been many Utopias, not one of which has answered the requirements of reality. Even Communism—tried by the Early Christians, and proved by them to be an utter failure—could not exist.

It has always struck me as a curious fact that women, when disappointed in their *true mission* (I shall not say any more about Iago's conclusions), generally take to extreme theological rituals or discipline, usually as devout *collaborateurs* with sucking bishops,—*i.e.*, with acute mental saintly curates, who all think they carry a mitre in their knapsack,—but C. N. or C. A. seems to have taken the other tack, and worships the inert instead of the ideal and the active. Poor Lady; be she maid, wife, or widow, I wish for her more wholesome idiosyncracy, and that she may arrive at the conclusion that animals are something more than automata; that in the construction of worlds and natural phenomena there were other elements than chance; that the things of sense are of stable consistency (phenomenal objects), and are something more than the creation of human brains; and that the brain itself is but an animal product progressing with animal development, and that it, in fact, is but an engine of a manifestation instead of the creator of its own manifestation.

In conclusion I would say my object was not to wound feelings, but to show up absurdities depicted as truths, and to expose the crude philosophisings intended as expositions. It is quite true that no real thinker or searcher for truth would have been misled by the rhapsodies; but unhappily in our world of men there are few real thinkers or true searchers for truth. The rabble—*i.e.*, the unthinkers, caught by the glare of words and possible advantages—accept the most absurd hypotheses for veritable truth, and are easily misled, as we daily experience in the rabble teachings of the times. Hylo-Idealism is one thing, but the intelligent conception of things as they be is quite another.

S. Billing.

HEALTH EXHIBITION NOTES.

In your notes on the above mention is made of the use of a mixture of lead and tin for tinning brass and copper vessels. The quantity of tin necessary for this is so exceedingly small

that lead would never be used except by the most disreputable makers of the cheapest and commonest articles, who are cut down to farthings in their prices by middlemen having no reputation to lose. To suggest that such a mixture is used by any decent maker of tinned articles is an injustice to the trade generally, which certainly should not be saddled with the sins of a few rogues. On page 356 you state that "it is a strange thing we cannot obtain in this country stoves of glazed earthenware." They *can* be obtained from several English makers,—amongst others from Doulton of Lambeth, and Cliff and Sons of Wortley,—but being costly they are very rarely put in a house by any tenant, whose property they would remain, and therefore their use is very limited. In countries where the winter cold is excessive, and fuel is dear, stoves are almost universally used, and are built with the houses, remaining the property of the landlord; whereas in England very few will use any stove, and being used for temporary or commercial purposes the cheapest and most portable forms are almost always selected. The same remark applies to gas-fires, which, being used as a makeshift or addition to existing arrangements, are almost unsaleable, except in the cheapest possible forms. Few tenants will go to the expense of removing an existing fireplace for a better one, with the risk of having to remove it when they leave the house; and for this reason there is little hope for the adoption of costly porcelain stoves or well-made and well-finished gas-fires, both arrangements being looked on as a temporary makeshift to be obtained in the cheapest form, with little consideration as to either beauty or efficiency.

THOMAS FLETCHER.

[We cannot accept "respectability" as evidence against analytical results.—ED. J. S.]

THE METROPOLITAN BOARD OF WORKS AND THAMES POLLUTION.

SINCE you allowed me to point out the mistake of the Board of Works in attempting to purify the Thames with chloride of lime, you will perhaps permit me to say a few words on the still more absurd scheme which they have now taken up—treatment with permanganate of potash or soda.

It is doubtless not generally known to the ratepayers of London that this substance is generally worth upwards of £100 per ton,—sometimes as much as £140! The Board are indeed sanguine enough to hope that by setting up works of their own they can

manufacture permanganate of soda at from £24 to £30 per ton. Any practical maker of permanganate will laugh at this notion. Soda is certainly cheaper than potash, but the Board will find that permanganate of soda is much more difficult to make than permanganate of potash, and that very much more than the theoretical quantity of alkali is required.

But even were they to succeed in obtaining the product at £24 per ton, and if the additional outlay did not exceed the modest £200 daily on which they calculate, we must remember that all this is pure waste—a simple addition to the heavy expense already going on. Not a farthing's worth of any valuable matter will or can be recovered from the river!

In a sanitary point of view the Board are equally mistaken. To destroy all the putrescent and putrescible matter in water by means of permanganate, a very large quantity of the disinfectant must be used, and the mixture *must be boiled!* Otherwise much of the organic matter escapes destruction, and quietly goes on putrefying, and the nuisance continues. We must also remember that permanganate has, in the cold, very little action on those minute living organisms which are now known to be the germs of infectious disease. I have seen such organisms retain their vitality for hours in water tinged a decided rose-colour with permanganate of potash. The same fact was recorded by Mr. W. Crookes, F.R.S., in a communication to the British Association, as far back as 1866. In short, permanganate—though it may remove some of the products and the outward signs of putrefaction—leaves the cause of the mischief untouched.

Lastly, the addition of permanganate to water leaves it always in an alkaline condition,—the very state most favourable to putrefaction and to the increase of disease germs!

I can only wonder at the obstinacy with which the Board avoid the only feasible method of dealing with this evil, and at their ingenuity in devising futile expedients.

ARGUS.

STURGEONS.

ARE we to understand that the Shovel-nosed Sturgeon which "exhibited on the surface no sign of eyes" was a normal or an abnormal specimen? If normal, one would like to know more of its habits. I have a theory that the common sturgeon lives mainly on flatfish, such as skates and thornbacks, and that while its snout is for hunting them in the mud or along sand or gravel, its very powerful sucker is for seizing and devouring them while

its armour is for defence against the spines and thorns of the victim's tail. Perhaps the sucker is also used for devouring spawn. The Sturgeon's tail is heterocercal, in order to wave above the ground while keeping the Sturgeon close to it. Why are sharks' tails heterocercal?

JESSAMINE.

A FRIEND has shown to me that the flowers of the Jessamine are visited by humble bees which gnaw through the side of the calyx, instead of thrusting their probosces down it, and soon after the calyx drops, and, I believe, the pistils are unfructified. Considering the length of the humble bee's proboscis, it is hard to believe that it would have difficulty in reaching the honey on account of the length of the calyx, and I suggest that it may be from want of a perch that it is led to abandon the usual way. The marvellous way in which some flowers, such as snapdragons, are adapted to give perch to bees and to fit their feet as they open them, seems to me beyond chance and *unconscious selection*. Has not the plant a *conscious* effort towards an end? Time may come when Descartes's notion of unconscious mechanism will be rejected in favour of plants as well as animals. But to return to the Jessamine: I venture to *guess* that it is fructified by the *hawk-moth*; and my reasons are that it is not adapted to bees, yet its scent is to draw some day insect with a long proboscis, and that insect is either very light or it does not need a perch, and in England it is very rare, like Jessamine seed. Indeed, the only place where I have found the hawk-moth frequent, is the Yorkshire coast. Can anyone help me with a suggestion? I have re'd (for my sake don't spell that past participle like the present tense!) somewhere that all our Jessamines originated from a specimen in Tuscany.

HUGH BROWNE.

Nottingham, August 19, 1884.

[Our Correspondent omits to state what species of hawk-moth. We have several in England, though none of them exactly common.—ED. J. S.]

SEX.

YOUR argument against "mad competition" for shutting men out from marriage, is good as far as it goes; but it does not go so far as the fact that there are about 600,000 more females than males in the kingdom; and the misery comprised in this fact is

beyond measurement! The origin of sex is well worthy of research; but it is wonderful how few and unmethodised are the observations on it. Colenso notes that a majority of eldest children are females. I have seen somewhere (probably in one of Captain Burton's books) that in a district of Brazil there are four females to one male, and I have read something similar of the Philippine Islands: then we have a few facts or disputes about the production of sex in bees, caterpillars, &c., and it is said that short eggs produce hens and long eggs produce cocks. Poultry keepers are said to have a way of telling the sex of an egg by observing the germinal spot through the shell, and Earl Spencer noticed a disproportion of sex among the progeny of particular bulls; but such loose observations are not science. Let us have science.

Why should I not make you my Matrimonial Gazette? I have emerged from the "mad competition," but I have been four years a widower from want of meeting the right lady, although I am vain enough to think that Captain Galton would not object to put me in his list of eligibles on any ground, mental, moral, or bodily. Applications may be sent to you! They must be from friends, not from the ladies themselves.

WIDOWER.

August 9, 1884.

BEES AND FLOWERS.

I HAVE met with two difficulties in the relations between bees and flowers which, perhaps, you or some of your correspondents may solve.

We are told that when a bee sets out from the hive on a honey-gathering excursion it visits merely flowers of the same species or at least of the same genus. I should like to know how this rule acts with respects to flowers which are at once rare and attractive to bees. I have noticed a very fine passion-flower of the blue species trained against the wall of a cottage, about a mile from the nearest village. In that village, as far as I have been able to ascertain, there is not another passion-flower growing. Nor are there, I believe, any bee-hives. Yet, the passion-flower in question is abundantly visited by bees, which, if they do not also visit other flowers of totally different orders, must fly from and to a very great distance, solely for the sake of the twenty or thirty blossoms generally to be found on this plant.

There is another difficulty with respect to the fuchsia. The blossoms of this shrub are well known to be remarkably rich in honey, and their colours are fairly conspicuous. Yet, as far as I

have been able to observe, fuchsias are very rarely visited either by bees or butterflies. Is this due to their shape, which affords no resting-place for the bees? To judge from their colours they should be entomophilous, but by what insects are they fecundated?

ALASTOR.

SCIENTIFIC NOMENCLATURE.

My strictures on long names have called forth, at least as far as chemistry is concerned, a reply marked both by courtesy and ability. But I fear I have not succeeded in making myself understood. I am no enemy of system, and most readily grant all the writer brings forward on that head. My contention is that long and so-called significant names are not necessary to system. Thus, to take an instance from a subject more familiar to me than is Chemistry, if anyone tells me that a certain insect, which I have never seen, belongs to the family Buprestidæ I know at once its embryology and subsequent development, its general structure, and its habits. Yet the word "Buprestis" is worse than unmeaning, it is mismeaning, since it conveys the idea that the creature concerned is hurtful to oxen. Yet this word completely answers its purpose in systematic terminology, and is reasonably short. I do not see why a nomenclature of a similar character might not be introduced into chemistry.

FRANK FERNSEED.

TECHNICAL TRIALS.

YOUR correspondent "Nomikos" has lately met both with a confirmation and—in part at least—a refutation. A recent action for libel, where the editor of a provincial paper was fined £50 for reproducing the Report of a Medical Officer of Health on a matter or great public moment, proves both that "technical trials" are not the most unsatisfactory of all legal proceedings, and, on the other hand, that juries are not to be trusted

CESTRIAN.

WEATHER FORECASTS.

It seems to be overlooked by meteorologists that when a season has taken a decided character, whether as wet or dry, the ordinary indications of a change seem to lose their meaning. In 1879 all signs of fair weather, drawn from the appearance of the clouds, the actions of birds, and insects, &c., were quite misleading. And in the present season I have more than once seen the commonly accepted signs of rain go for nothing. The sky may become gradually overcast, with dark, ragged masses of underscud,—there may be a "hollow and a blustering wind," swallows may fly low, slugs come out in numbers, bubbles of gas rise from ditches, &c., but the weather remains dry, or at the most, there is a slight shower.

A Dweller in the Chilterns.

WASPS AND THEIR HOURS OF ACTIVITY.

Wasps are very plentiful this year in my neighbourhood, and I notice that twice daily they have times of especial activity. From about half-past 9 till 11 in the morning they are very busy; from then till nearly 2 we see but little comparatively of them, and after that they resume business until nearly 5 p.m. Is it known whether wasps and bees can recognise any man, dog, or horse which has happened to disturb them, or will they, if angry, attack indiscriminately any large animal which happens to come in their way?

J. C.

NOTES.

We learn that the Corporation of Plymouth has subscribed £1000 towards the erection of a Marine Zoological Station. The general public, however, seem little disposed to follow their example and that of H.R.H. the Prince of Wales.

The Academy of Sciences has invited correspondence on the treatment of cholera, and has appointed a Commission to examine the 240 letters received. The result is summed up as follows:—"Secret remedies, means of no value, therapeutic agents already tried." Most of the writers are laymen, and they give not the smallest fact in support of their assertions.

According to M. A. Barthélemy the respiratory act in the animal *Convoluta Schultzii* consists in the absorption, through the cuticle, of dissolved carbonic acid which the chlorophyll present decomposes, producing oxygen. This oxygen is utilised by the animal, very little being exhaled.

At a recent meeting of the Academy of Sciences M. Xamben referred to the deplorable custom, still kept up in certain country places, of ringing the church-bells during thunderstorms.

According to MM. Perrin and Dujardin-Beaumetz, alcohol is sometimes present in the animal system when it has not been introduced from without.

M. J. Künckel ("Comptes Rendus") shows, in refutation of Weissmann, that in the pupa-state of the Diptera the heart continues to beat during the phenomena of histolysis, and whilst those of histogenesis begin to be manifested. The short epoch of stoppage of the heart does not mark an appreciable interval between these two processes.

MM. G. Bonnier and L. Mangin ("Comptes Rendus") conclude from their experiments that sunlight, direct or diffused, diminishes more or less the intensity of respiration in the non-chlorophyllaceous parts of plants. For the same individuals the ratio $\frac{CO_2}{O}$ of the volume of carbonic acid emitted to the volume of oxygen absorbed is the same in light and in darkness.

We hear that a Ministry of Education is about to be established in these realms, and that this important office is to be filled by — Mr. Mundella!

The National Health Society has recently issued a pamphlet on the Vaccination question, bringing forward some very decisive cases in favour of this precaution.

Why is Bestiarianism an apparently capital point in the creed of the Positivists?

According to the "New York Sun" a pair of orioles in Central Park, finding the twig on which they were building their nest too weak, secured it to a branch above by means of a string.

M. G. Carlet ("Comptes Rendus") shows that the venom-bag in the bee, and the other Mellifera, is not—as in the wasps, &c.—furnished with muscles for the expulsion of the poison. The two rods of the sting play the part of an aspirator and an injector.

Dr. Wadsworth, in the "American Naturalist," continues his demonstration that the interior of the earth is not solid.

General Butler is very justly rebuked, in "Science," for saying that "the higher education of the few mainly affects themselves."

It is not generally known that Lord Byron's daughter Ada, afterwards Countess of Lovelace, possessed very high scientific attainments. Her translation of General Menabrea's exposition of the analytical engine of C. Babbage, with the accompanying critical notes, proves her to have been a mathematician of no mean order.

M. J. Fischer ("Revue Scientifique") gives an interesting account of observations on monkeys, especially *Macacus rhesus*. This animal, having been frightened at seeing a gun discharged at some sparrows, extended his fear to a toy pistol appended to his master's watch-chain, and even to the figure of a revolver in an armourer's illustrated catalogue. Several species of monkeys recognise pictures of animals,—a proof of the superiority of their intelligence over that of dogs and elephants. The *rhesus* knew the names of some sixty to seventy animals confined in cages in the same room. He could fully understand the expression of the human countenance, could estimate weights, and had a certain—though not strong—sense of number.

Dr. Fromont ("Popular Science Monthly") seeks to account for swarms of Lepidoptera encountered at sea as having been developed from pupæ contained among the cargo,—a somewhat insufficient explanation.

Mr. C. M. Hollingsworth discusses, in the "American Naturalist," the theory of sex. His conclusions differ from those of Mr. Starkweather noticed in our last number, as he considers that the epoch of fecundation is decisive.

Darwin's views on the formation of coral reefs are being to a considerable extent called in question.

According to the "American Journal of Medical Science" the time taken by the blood of the dog in making the entire circuit of the body is 17·5 seconds, during which the heart makes 51·5 pulsations.

Dr. C. C. Abbott, in his "Rambles about Home," informs us that "crows have twenty-seven distinct cries, calls, or utterances, each readily distinguishable from the other, and each having an unmistakable connection with a certain class of actions."

L. Stejneger, writing in the "American Naturalist," mentions the curious fact that the ptarmigan, as well as other birds of the family of Tetraonidæ, regularly sheds its claws every summer.

Mr. J. M. Wade ("Science") notices that certain hairs of wool have perfectly circular perforations, apparently made whilst growing, by some creature as yet unknown.

Prof. Winchell, in a Lecture on the "Habitability of Other Worlds, reported in "World Life," remarks that there may be beings on other worlds, and even on this, which possess more numerous senses than do we.

We regret to learn that Sir J. Lubbock cannot, as he intended, be present at the Montreal meeting of the joint British and Canadian Associations.

"Wilford's Microcosm" is still existent, carries on its crusade against Evolution and the wave-theory of sound, and speaks of Prof. Tyndall as "silenced," because he is not willing to waste his time in useless logomachy.

"Science" advocates the adoption of the trinomial system in the organic sciences.

H. Struve ("Journal für Prakt. Chemie") maintains that all animal cells have the property of swelling up in ether, whilst nothing similar occurs with vegetable cells.

M. A. Milne-Edwards ("Comptes Rendus") shows that the fœtal membranes of the aye-aye differ in no essential character from those of the typical Lemurians, and are clearly distinguished from those of the Primates and the Rodents.

M. A. Mairet, in a communication on the influence of intellectual work on the elimination of phosphoric acid by urine, read before the Academy of Sciences, concludes that phosphoric acid is intimately connected with the nutrition and action of the brain. The brain, when active, absorbs phosphoric acid combined with the alkalies, and returns it combined with the earths. Intellectual work retards general nutrition, and modifies the elimination of phosphoric acid by the urine. It diminishes the amount of phosphoric acid combined with the alkalies, and increases the hosphoric acid combined with the earths.

M. Schnetzler (" Archives de Genève ") states that the most resisting bacteria are instantly killed by water containing one-thousandth part of formic acid.

M. Feltz (" Comptes Rendus ") finds that the immunity against " charbon " obtained by vaccination does not extend beyond seventeen to eighteen months.

M. Chamberland informs us that the most impure waters, if filtered through unglazed porcelain, retain no microbic germs.

M. A. Carnot shows that the quality of coal depends not merely upon the age and the circumstances to which it has been exposed, but also upon the species of plants from which it has been formed.

We learn, with extreme regret, that the problem of aërial navigation has apparently been solved, and that the saturnalia of crime and outrage are consequently close at hand.

According to M. A. Mairet (" Comptes Rendus ") madness modifies—in various manners, according to its stages—the elimination of phosphoric acid and nitrogen by urine. It increases the nutritive changes which take place in the nervous system. The general nutrition is intensified in periods of excitement and lowered in periods of depression.

According to " Science " a " summer school " of Economic Entomology has been opened at Cornell.

The scientific world has to regret the death of another eminent French chemist, Paul Thenard. Discoverers die, whilst speech-makers and agitators live on.

The Royal College of Surgeons, under the will of the late Sir Erasmus Wilson, is likely to receive a legacy of £180,000.

Examinationism has just scored another deplorable triumph. The ranks of surgeon-major and brigade-surgeon are in future to be reached, not *rebus gestis*,—not by the practical display of skill, tact, and resources, but by examinations! Thus the glib talker will here, as elsewhere, be lord of the ascendant.

We are glad to learn, from a medical contemporary, that kairine is uncertain in its action and transitory in its effects, and not to be compared with quinine.

It is said that the cholera germ described by Dr. Koch had been discovered thirty years ago by Dr. Filippo Pacini. In a treatise published by Pacini in 1854, in the " Italian Medical Gazette, and which was subsequently translated both into French and English, he declares the cholera due to the action of " a very simple organism, which I shall call the choleraic microbion."

TWENTY-FIRST YEAR OF PUBLICATION.

THE

JOURNAL OF SCIENCE,

AND ANNALS OF

ASTRONOMY, BIOLOGY, GEOLOGY, INDUSTRIAL ARTS, MANUFACTURES, AND TECHNOLOGY.

(MONTHLY, FORMERLY "THE QUARTERLY JOURNAL OF SCIENCE.")

Vol. VI. ([illegible])
No. CXXX.

OCTOBER, 1884.

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LONDON:
3, HORSE-SHOE COURT, LUDGATE HILL

Where Communications for the Editor and Books for Review may be addressed.

PRICE ONE SHILLING AND SIXPENCE.

THE

JOURNAL OF SCIENCE.

OCTOBER, 1884.

I. MORAL EPIDEMICS AND CONTAGIONS.

THE word "moral" is condemned to serve as a kind of general antithesis, whenever such is needed. Thus it is alike employed in opposition or in contradistinction to "immoral," to "intellectual," to "logical" (as when men speak of a moral certainty or a moral impossibility), and to "physical." It is in the last sense that we shall make use of it.

The contagion of moral phenomena, and their propagation to a distance, has been recognised in all ages. It would be very superfluous to give instances of the spread of delusions, manias, hysteric phenomena, &c., since the chronicles of the dancing mania, of the doings of the flagellants, and the like, are duly recorded in history.

But one consideration must not be overlooked. The epidemiologist can tell us of the inroads of plague, of cholera, of smallpox. But they have no case on record where an epidemic of higher health, of increased vigour, has overspread a country or a continent. Just in the same manner with moral and intellectual phenomena: we are familiar with the spread of delusions, of follies, but we find no instance of a sudden and seemingly unaccountable fit of sound sense or rationality sweeping over a body of men, a class, or a nation. Hence we have the corollary that any "movement" or agitation, be it political, social, or religious, is in all probability essentially morbid in its origin and character. It is a pathological phenomenon most prevalent among individuals of ill-balanced intellect, and in nations where the penumbra of mental derangement is broadest.

For instances we need only point to the "Anti-Vivisection" movement, to "Anti-Vaccinationism," to the opposition to the "Contagious Diseases Act," to the examinational mania, and the like.

Now the causes of the spread of such "movements" have not been hitherto understood. We may therefore, with advantage, take into consideration the views which M. J. Rambosson has brought forward in memoirs read during the last few years before the Institute of France. He points out that the spread of delusions has been hitherto accounted for by strange and contradictory hypotheses.

It has been ascribed to miasms, to indefinite commotions, to imitation, to fascination, to witchcraft, or demoniacal obsession.

M. Rambosson has shown that this contagion depends on a single law, easy to be demonstrated, and at once most simple and exceedingly vast in its sphere of action, if we may judge by the number of phenomena which it governs.

The cause of the contagion is due to the transmission of the cerebral movement to which the phenomena in question are due in the individual.

This transmission takes place from brain to brain, through the ambient medium, without being modified by its successive transformations, just, *e.g.*, as the *materies morbi* of yellow fever retains essentially the same character, no matter through how many successive persons it may have passed. It reproduces, or tends to reproduce, in the persons whom it reaches the same phenomena as in the persons with whom it originated, such as yawning, neuralgia, epileptiform phenomena, panics, madness, suicide, identical or analogous crimes.

When it has reached the brain this movement is not extinguished, but it is transmitted to the nerves and muscles, and is developed outwardly, reproducing the contagious phenomenon.

The action is, therefore, first centripetal and then centrifugal.

We are here reminded of the views of Professor Gustav Jaeger (*see* "Journal of Science," 1880, pp. 282 and 298), and we believe, to some extent, of Dr. B. W. Richardson (*see* "Journal of Science," 1881, p. 623). But both these *savants* refer the contagion of mental affections, or of insanity, to a material something given off, and not, like M. Rambosson, to a molecular movement capable of impressing itself on neighbouring organisms.

The cerebral movement which propagates itself from

brain to brain without losing its nature may be followed, thanks to the means which Science puts at our disposal, step by step, from its point of departure to its point of arrival, without being lost to sight for a moment or escaping from our observation. There is here nothing hypothetical.

This propagation of the identity of the cerebral movement has not been contested by any of the *savants* who have followed M. Rambosson's demonstration. It appears that this movement produces different phenomena in different media, but without changing its nature,—*i.e.*, it reproduces identical or analogous phenomena whenever it encounters an identical or analogous medium.

In this law of the transmission and transformation of the movement which produces the contagion there are two principal points to be considered:—

1. The cerebral movement which passes from brain to brain without changing its nature.
2. The reflex action which this movement tends to determine after reaching the brain, and which becomes the proximate cause of the contagion.

The reflex action which this movement tends to determine, and which realises the contagions in question, does not always take place, and this fact has raised some objections on the part of those who are not perfectly familiar with the nature of reflex action in its different phases. But these objections do not affect the law, which is indeed confirmed by their scientific explanation.

The contagion of nervous phenomena ensues, then, as the immediate consequence of a reflex movement.

All that is observed in the production of an ordinary reflex movement is equally observed in the propagation or contagion of these phenomena. There is an essential difference in the origin of the physiological movement which produces ordinary reflex action and that of the physiological movement which produces the contagion.

The first-mentioned has its origin in the same person in whom the reflex phenomenon is manifested; whilst the other, producing the contagion or the propagation of the phenomenon to a distance, has its origin in a strange brain (a very strange one, sometimes, in a quite different sense of the term !), and is transmitted through the ambient medium to the brain of the person whom it attacks.

For instance, digestive troubles or hindrance in respiration give rise to a centripetal movement which on arriving at the

brain produces yawning. Such yawning is evidently not due to contagion; it is symptomatic of some direct cause, and it might be called spontaneous.

But this yawning may become transmissible, because the cerebral movement under the influence of which it is produced may be transmitted to other brains without altering its character. It thus gives rise to an indirect reflex action, and to what is called the contagion of a nervous phenomenon.

This indirect reflex action is very remarkable from the origin of the movement which determines it, and must be specially distinguished from the other.

In more complex cases the process is not dissimilar. A man of strong will, a believer in himself, possessing great self-reliance, or at least a great power of self-assertion,—we mention here no names,—falls under the influence of "dominant ideas." We have not here space for the analysis of the process, but these dominant ideas are quickly transferred to the brains of others, and may become an epidemic, local, national, or universal. We may remark that the moral contagion from a powerful brain is dangerous in proportion to its power, just as is perceived in the transmission of diseases from one animal species to another.

M. Rambosson has carefully studied the circumstances attendant upon this reflex action. Careful and minute observations and repeated experiments have led him to the following observations:—Many of these results have been recognised in ordinary reflex action, but they catch a new light from the application thus made of them to the transmission or propagation of nervous phenomena. Others of the results have been newly discovered by M. Rambosson.

1. Those reflex movements which produce contagion are sometimes conscious and at other times unconscious. They may be automatic, instinctive, or voluntary and reflective.

Thus, for instance, if any person yawns in our presence we may allow ourselves to yawn without being aware of it, and may even be surprised to find ourselves yawning.

At other times we are perfectly aware that we are about to yawn.

At other times, again, we resist the yawning, and by a voluntary reflective act we neutralise the reflex movement which tends to display itself outwardly in the form of yawning. And by frequently repeating this effort we become at last able to neutralise the movement without much

difficulty. This can be remarked in all persons who are accustomed to respect the usages of good society.

Further, we remark in such persons that they acquire the power of resisting this reflex action instinctively, and even unconsciously, the reflective voluntary resistance thus becoming instinctive by repetition.

This fact is important, since the truth which it teaches may be generalised and be applied to *other contagious nervous phenomena.*

Thus men who have reached a certain stage of culture, intellectual and moral, become proof against the contagion emanating from the platform orator, and, retaining their cool judgment, they smile at his rhetoric; they see through his sophisms, and detect the nature of his *quasi*-facts. Should the people of England ever reach this stage, the professional agitator will have to seek some other calling.

A number of automatic movements may, by attention and exercise, pass under the dominion of the will, and in like manner a number of actions originally voluntary and reflective may by dint of exercise become automatic, and this as well in ordinary reflex actions as in those which give rise to contagion.

2. Various similar movements, simultaneous or successive, may be produced in an assemblage of individuals, and may thus give rise to reflex actions concurring to one and the same effect. We see this especially in military exercises where similar movements are executed together.

Says the Baron Larroy, "It is in the manœuvres of troops that precise and rapid reflex actions are best seen and appreciated. . . . There remains an influence which must be taken into account in this study of the reflex actions that is the influence of proximity, of individual upon individual. Contact in the ranks produced the most decided reciprocal or reflex action in a troop.

"Is it not, in a situation of a quite different order, what may be observed in the case of two performers singing a duet, if they hold each other by the hand? It has often seemed to me that thus instinctively approximated by tactile union they understand and support each other the better, giving to the piece which is sung more accord, more correctness, and more harmony; such is the reflex action of music."

3. The contagious reflex movement, under the influence of the same causes, is not exerted equally, nor at all times upon all persons.

Thus if any one yawns among those present, some are at once induced to do the same; others either not at all or only after a second or a third repetition of the action.

In an independent work* M. Rambosson has adduced some curious facts on this subject. Thus repetition does much to determine the contagious reflex movement,—a fact well known to physiologists as regards ordinary reflex movements.

Each separate movement is added and accumulates, and the sum of all these separate movements produces a reflex action more energetic than if the whole had ensued at once. Series of experiments have shown that such movements may assist each other even when separated by an interval of several seconds.

We find in a classical work† the following passage:—"An excitement too feeble to induce a reflex movement may become effective by being repeated. Ten, twenty, thirty slight shocks, repeated at intervals of a second, may in some manner add themselves together, and determine a reflex action even more energetic than would the sum of all these small shocks acting at once. Mr. Stirling has remarked that feeble excitements may multiply their effects even when they are separated by intervals of two seconds."

In certain cases it has even been found possible to measure the sum of the excitements necessary for the production of reflex action.

4. One and the same reflex movement may produce opposite effects, according to circumstances.

This phenomenon is important to establish, since its explanation becomes fruitful by the light which it throws upon all analogous facts.

For instance, a military march is heard. As soon as the sound-waves reach the brain of the hearers a reflex movement is produced which impels each one to follow in his own movements the cadence expressed.

We often see even children manifest this with perfect accuracy.

* "Les Phénomènes Nerveux Intellectuelles et Moraux; leur Propagation par Contagion." Paris: Firmin-Didot.

† Beclard's "Physiologie," 2e part., p. 426.

The men marching are naturally aided by this movement, and follow its impulse spontaneously.

Persons at rest feel all their limbs more or less agitated by the same cadence, and express it instinctively in one or another manner.

This reflex movement determined by sound-waves may thus be recognised in a very striking manner.

But here we are led to another important observation: this cadence aids, by the reflex movement, the men who have to march, sparing them the fatigue of a movement which they would otherwise have to give themselves in a direct manner.

This explains the reason, hitherto unknown, of analogous influences which are observed in a multitude of cases.

For persons who wish to remain in a state of total rest—or, indeed, to act in some heterologous manner—these sound-waves, when they excite their corresponding reflex action, will prove annoying instead of agreeable. Such persons will feel fatigued instead of aided, for, in order to keep still, they will have to struggle against this reflex movement just as we struggle against the reflex movement which tends to reproduce yawning, when we do not wish to yield to it.

These considerations are fruitful in consequences. By their means we are led to recognise the physical and moral influences of music and of all the fine arts,—not forgetting eloquence,—to formulate the laws of this influence, and to determine with precision their sanitary and therapeutical applications.

This *modus agendi* of the contagious reflex movement explains facts to which it would seem at first quite inapplicable.

We may generalise these notions and explain scientifically a number of facts which otherwise appear contradictory.

Sometimes, for instance, we love gay impressions, whilst sometimes we love melancholy impressions. If we have motives for giving ourselves up to sadness we have a satisfaction in this condition. At such times smiling countenances, joyous songs,—in a word whatever is gay annoys us, because we are obliged to struggle against the reflex contagious movement in order to remain in the state which we have chosen. On the other hand, everything conducive to sadness will please us, because it agrees with our condition. Gay impressions fatigue us, and do not readily

exert on us a contagious action, on account of the instinctive struggle of the *ego* against the reflex action which tends to produce them.

(To be continued).

II. ON THE DISTRIBUTION OF COLOURS IN THE ANIMAL WORLD.

SIGNOR LORENZO CAMERANO has been for some time engaged with the study of the distribution of colours in the animal kingdom. He has communicated his results to the Academy of Turin, and has given an abstract in the "*Zoologischer Anzeiger*" for July last.

He first examines the respective frequency of occurrence of different colours in the animal world, and arranges them in the following order;—1, Brown; 2, black; 3, yellow, grey, and white; 4, red: 5, green; 6, blue; and 7, violet, the rarest. It will be observed that Signor Camerano ranks here black and white, and their mixture grey, as colours.

These colours are, however, by no means equally distributed in the main groups of the animal kingdom. Black, brown, and grey, we are told, are more abundant—relatively of course—among the vertebrates than among arthropods. Red and yellow, on the other hand, are more frequent in the evertebrate animals. Green, also, is frequent among the lower animals, with the exception of the molluscs, but is also abundant in vertebrates, though, it might have been added, not among mammals. Violet and blue are the rarest colours, especially violet, though we meet with it in almost all animal groups. White is very irregularly distributed, but occurs most frequently among aquatic forms.

The colours of animals are, on the whole, directly related to the medium which they inhabit.

Parasites have less decided and less manifold colours than those which lead an independent existence.

Aquatic animals have in general more equable and less intense colours than terrestrial forms. Pelagic species have

rarely striking deep colour,—a fact which must be connected with the frequent transparency of their bodies.

Sea-animals which live among Algæ, and in situations rich in marine vegetation, have a more varied and lively range of colouration than such as live among stones or on the sandy bottom.

The dull, sombre colouring of fresh-water insects needs only a passing notice.

High- and strong-flying birds have not, in general, a striking colouration.

Land-animals, which live in the woods, beneath herbs, on bushes, or on flowers, &c., have more manifold and more striking colours than the inhabitants of bare sandy or rocky localities. The "Desert colour" of the Arabian and Saharan fauna has been particularly insisted on by Canon Tristram.

Contrary to the somewhat premature assertion of Mr. Grant Allen, there is no universal and constant connection between the colouration of animals and the nature of their diet. Insectivorous, or rather zoophagous, animals, which live under leaves and among flowers, have often brilliant and varied colours; whilst phytophagous species, if they do not regularly inhabit leaves and blossoms, are often dull and monotonous in colour.

Still this generalisation is as far as that of Mr. Grant Allen from accounting for the splendid colouration of, *e.g.*, the genus *Phaneus*, devourers of excrement and carrion, among which they have their dwelling.

The richer an animal group is in species the more varied, and in many cases the brighter, is their colouring. This law is well illustrated by the humming-birds. But it fails us in not a few striking cases, among which we need merely mention the great group of the Brachelytra, or rove-beetles, the Harpalidæ, and the genus *Aphodius*.

The development of colour bears no direct relation to the proportion of light to which the animal is exposed. It is rather directly connected with the general development of animals. Defective nutrition and diseases impoverish the colours.

We need scarcely add that the views of L. Camerano, as regards the influence of light, agree substantially with those of Mr. A. R. Wallace.

A very dry climate seems to darken colours, whilst a very moist one rather brightens or lightens them. The colours of animals are modified by the altitude of the station of a species above the sea-level. The higher we

rise the more intense are the colours which we encounter.

With this proposition we can scarcely agree. A mountain fauna is generally speaking more sombre than that of the adjacent plains,—a remarkable contrast to the Alpine flora. This fact has indeed been cited as an argument against Mr. Grant Allen's theory of the colouration of animals.

Species confined to islands have often darker colours than those inhabiting continents. This conclusion holds strikingly good as regards many varieties inhabiting small islands.

It will be seen that the colouration of any given fauna is a result depending on a complex of factors, the respective influence of which it will not be easy to estimate.

The different zoo-geographical regions of the earth seem to have certain more or less predominating colours.

In the Palæarctic region white, grey, black, and yellowish are frequent; in the Ethiopian, yellow and brown; in the Neotropical, green and red predominate; in the Indian the yellow tones occur very plentifully; whilst in the Australian dark colours, and especially black, take the lead.

Generally speaking, throughout the animal kingdom the more bulky forms have more monotonous colours than smaller forms belonging to the same group.

In almost all groups of animals those parts which are less visible are often brightly coloured or spotted, whilst the other parts of the body are more frequently uni-coloured and dark. Here, however, we are reminded of the very numerous cases in insects where the brightest colours appear to be seated in projecting parts, such as the extremity of the abdomen, the tips of the elytra in Coleoptera and Hemiptera, the margins of the wings in butterflies, &c. So frequent is this phenomenon that some naturalists have thought it a protective arrangement,—a bird, *e.g.*, being more likely to strike at these brightly-coloured out-lying parts than at the more sombre vital regions.

Sexual colours are directly connected with the general development of animals. The males have in general brighter colours. In many cases, however, where the females are larger and stronger than the males, they, in turn, are the more gaily coloured.

The colouration of young animals is often very different from that of the adults, and—where a sexual difference exists—it generally resembles that of the female, in which consequently "Neotenism" (*see* "Journal of Science," 1884, p. 531) is recognised. In many cases the young of different

species resemble each other closely in their colouration, though the adults are quite distinct.

Whilst thus giving an abstract of the very interesting results of Signor Lorenzo Camerano, we are fully conscious that some of them—as we have pointed out—require further consideration. It must have struck many of our readers that researches on the colouration of animals have, so far, left the physical side of the question scarcely touched. The production of the colouring-matters, their occurrence in one species and not in another, and the mechanism of their distribution have still to be dealt with. It strikes us that in the production of the design—in, *e.g.*, the wings of a butterfly—the principles of capillary attraction and of diffusion must come into play. By mixing certain colours which have different rates of diffusion, and placing a small drop of the mixture on white blotting-paper, designs may sometimes be obtained which roughly resemble those we meet with in the wings of Lepidoptera.

III. THE HEALTH EXHIBITION.
No. III.

ONCE more we return to this popular display to notice a few points which we had previously overlooked. Disinfectants are, as a matter of course, not absent. As sings the poet Buchanan :—

> "Down the steep valley, on her ass
> Rideth the maiden Sanitas."

Messrs. Savory and Moore have a fine collection of the leading antiseptics of the day,—salicylic acid, phenol, eucalyptol, thymol, &c. The phenol (pure) is very slightly tinted with pink, the inevitable result of exposure to light. All these specimens are exceedingly beautiful.

"Ozonine" deceived us: we expected that it was some novel antiseptic; but behold, it is a beverage, to be consumed instead of champagne.

We were particularly struck with the exhibits of the

"Iciple" Manufacturing Co., of Cannon Street. On the table was a common grass-snake (*Tropidonotus natrix*), preserved in a liquid named "Balma," and recommended as being superior to alcohol for such purposes. Every naturalist will agree with us that alcohol is a most troublesome article to carry about in semi-civilised—not to speak of savage—countries. It is sure to leak away or evaporate, and is, moreover, in great danger of being swallowed by the natives, unless they are Islamites,—sometimes along with the specimens preserved in it. A substitute not open to these objections would therefore be invaluable.

It would have been well if the Iciple Company had exhibited comparative specimens, say of snakes, preserved respectively in "Balma" and in alcohol. But "Balma" has, it appears, many other virtues; it prevents, we are told, "mortification in amputations, allays inflammation, cures cancers, diphtheria, croup, whooping-cough, thrush, ophthalmia, smallpox, scarlet fever, measles, ringworm, snake-bites, and all kinds of eruptions." If but a small portion of this is true the inventor may rank as a distinguished benefactor to humanity. But would he allow himself to be bitten, *e.g.*, by a cobra, in reliance on the curative power of "Balma"? A cure for smallpox would be even a greater boon, as it would at the same time be a permanent remedy for anti-vaccinationism.

"Weiher's Mosquito Fluid" is said to prevent the approach of mosquitoes. This preparation may not impossibly be the tincture of marsh-rosemary (*Ledum palustre*), a preparation which we know, from personal observation, banishes these pests.

The same Company manufacture "Crystalline," of which they say that "its chemical action, harmless and innocuous to human life, infallibly destroys every germ of impurity in water, leaving it pure, sparkling, and cold. It is an essential requisite in every household, and should invariably be used in drinking water, filtered or otherwise."

What will Dr. Jabez Hogg say? Surely if these claims can be substantiated,—if disease-germs and microbia generally in drinking water can be infallibly destroyed by a preparation harmless to human life,—the recent difficulty concerning the possible admission of sewage into our water supplies is overcome.

But this important article by no means exhausts the lists of the Iciple Company. "Purita" is described as "an aromatic and highly-perfumed powder, perfectly harmless, but which acts as a most effective antagonist to the very

origin of parasites and insects of all kinds, which are instantly repelled by its atmosphere, in which insect-life cannot exist."

"Weiher's Insect Powder," which may perhaps be the powder of *Pyrethrum roseum* or *carneum*, is thus described :—"This excellent preparation is the *only one* which immediately destroys all obnoxious insects, such as moths, fleas, bugs, cockroaches, ants, &c., and at the same time being perfectly harmless to all domestic animals.

Lastly, we shall mention a new "Embalming Powder." We do not, indeed, approve of the practice of embalming the dead, which is far less rational than cremation. But a preparation which "at once arrests decomposition of the dead" would be a great boon in dissecting-rooms, and to experts who have to undertake toxicological cases.

We think that, if only a part of the claims made on behalf of these preparations can be experimentally substantiated, M. Weiher deserves high honours and great emoluments as surely as the inventors of new explosives, flying-machines, &c., merit a short shrift and a high gallows.

The exhibit of the Society of Public Analysts is exceedingly instructive. They display a number of the vile materials used in sophisticating butter, coffee, and other articles of diet. In defiance of united grocerdom they truthfully proclaim chicory to be an adulterant.

The comparison between the sanitary and the unsanitary houses, placed side by side, is indeed instructive. In the latter we see a fair type of the class of "residences, replete with every modern convenience," which are let at from £50 to £75 yearly, and which bribed surveyors, every five years, value at a higher figure, so as to raise the rates and taxes and encourage the owner to raise the rent likewise. There is the sewer carried right under the floor of the building, in the form of doubtfully-connected drain-pipes; there are water-closets, in the centre of the house, without air and light; there is the soil-pipe delivering gases into the cistern, and the absence of any systematic arrangements for ventilation and for removing the products of the combustion of gas. But where are the improvements to begin? The "sanitary" house would probably cost more to build than its unsanitary neighbour. Hence the rent will be higher. A vast number of people will thus be driven to run the risk of sickness, which they may escape, rather than encounter higher rents and increased local taxation, which are inevitable evils. The first step towards "sanitary" houses must be the elimination of the middlemen who have thrust themselves in between

the ground-landlord and the tenant-occupier. The second step would involve the abolition of the convention by which a dwelling-house—in contradistinction to a place of business—is officially considered to become of higher value as the neighbourhood becomes dirtier, noisier, and more crowded, and as all who can afford migrate further out into the country, whilst their place is filled by a lower class.

It will have been noted that our correspondent, Mr. Thos. Fletcher, has little hope for the introduction of earthenware stoves instead of our dirty and uneconomical fire-grates. He forgets that such stoves need not be costly structures of porcelain. Ordinary fire-clay tiles answer just as well. He overlooks, too, the facts that fuel is much higher in price than it was formerly, and that our winter, though not so severe as that of Holland, Germany, &c., is quite as long. The fire-clay stove is more under control as regards the temperature to be obtained than is the grate under any of its modifications.

Whilst speaking of sanitary and insanitary houses we cannot help referring to the "Introduction" to the Official Catalogue. A marginal note speaks of "former ignorance regarding sanitary matters." We submit that popular notions on this head are ill-founded. The Books of Moses and the Laws of the Buddhists show an acquaintance with sanitary science on a level with the knowledge of the present day, and in too many instances sadly ahead of its practice.

Says the Catalogue:—"Systematic drainage and water-supply for towns and villages were not thought of." What of ancient Rome, far better supplied with water than London or Paris, and, so far as we can judge, as well-sewered? As for domestic architecture the remains of Pompeii are superior to our towns, no less from the sanitary than from the æsthetic point of view,—no jerry-work, no lurking places for vermin or for putrescent matter; everything sound, hard, compact, so as to be incapable of absorbing foul gases or fluids. It is sad, indeed, that with all the economies and all the over-work of the modern world its children cannot afford to be as healthily housed as were their predecessors eighteen centuries ago.

The ancients were certainly not unacquainted with the water-carriage of sewage, though we have no evidence that they tried any method of purifying waters so polluted. In China, indeed, the use of alum in cleansing contaminated waters, so as to render it fit for drinking purposes, seems to have been known and practised from time immemorial. A quantity of water from one of their muddy, impure streams,

on the addition of a pinch of alum, seems to curdle or flake. In a few minutes the suspended matters go to the bottom, carrying with them no inconsiderable portion of the dissolved impurities. Indeed the experience of the French troops in Tonkin shows that the microbia present, though not destroyed, are carried to the bottom, so that the clear supernatant water may be drunk with impunity.

This brings us to one of the most interesting features in the Exhibition,—the process of the Native Guano Company for purifying sewage, waste waters, &c., before they are allowed to fall into the rivers. The sewage is mixed with clay and waste animal charcoal, a combination which powerfully absorbs the offensive matters dissolved in the water. Sulphate of alumina, or the corresponding hydrochlorate (hydrated aluminium chloride), is then added, which not only carries down with it the clay and carbon, with all that they have absorbed, but precipitates a very considerable proportion of the organic matters, whether such may be in suspension or solution.

This process is to be seen at work daily, though of course on a very reduced scale. We cannot help referring to an error committed by a medical contemporary, who stated that vegetables grown with the manure produced by the Native Guano Company's process were equal to those produced by the irrigation system. This is exceedingly faint praise. As far as we have observed, vegetables grown on sewage irrigation farms are deficient in flavour and firmness, and soon pass into a very offensive putrefaction.

Three firms engaged in the manufactory of sanitary earthenware—Messrs. Doulton, of Lambeth; Cliff, of New Wortley; and Wilcock, of Burmantoft—are distinguished for the high quality of their exhibits, not a few of which, however, though admirable in themselves, have no immediately apparent connection with public health.

Painters' colours are strongly represented. The firms Griffith and Co., Freeman and Co., the Torbay and Dart Paint Company (Limited), Turner and Sons, and Hare and Co.,—all display series of colours understood to be free from all objectionable ingredients. A reform in this respect has long been needed. White lead, which is so extensively used alone, and perhaps in even greater quantities in admixture with other colours, is most injurious to the workmen employed in its manufacture, to those who use it, and in many cases to the inhabitants of houses to which it is applied. Lead has been characterised as the meanest, the most perfidious, of poisons. The victim who gradually

absorbs this metal into his system is often unconscious of the evil until recovery is almost hopeless. We therefore wish good speed to those who are endeavouring to supersede the use of this treacherous metal alike in paints, in water-pipes, in the linings of pans, &c., and in the glaze of earthen utensils.

Much has been said, from time to time, about the possible mischief resulting from the use of arsenic and antimony in the arts of dyeing and printing,—not only in the colours employed, but in mordants and other accessory preparations. This question does not seem to have received any special attention at the Health Exhibition; at least we have not come across any display of poisonous dyes and mordants in contrast with harmless preparations destined to supersede them. It has been sufficiently demonstrated, especially by Dr. Grandhomme, superintending physician to one of the largest manufactories of artificial colours in the world, that these dyes, as now prepared and issued, are non-poisonous.

In the so-called "pigment-style" of tissue printing, where insoluble, mineral colours are, so to speak, cemented upon the tissue by means of albumen, &c., poisons are certainly used, such as the arsenical greens.

The use of arsenical pigments in getting up wall-papers has been much discussed both in technical and non-technical papers, some of the statements appearing in the latter being exaggerated and sensational. It will be noticed by visitors to the "sanitary" and "unsanitary" houses that the papers on the walls of the latter are labelled as "arsenical," whilst those used in the former are marked as being "free from arsenic." In this case the green colours are evidently for the most part chromic oxide or its insoluble salts.

The most painful sight in the Exhibition escaped our personal notice. We have been told that there is on view a cloak, belonging to a lady of title, trimmed with the skins of a large number of harmless and beautiful birds. Against such outrages we are sure all naturalists will join us in protesting. The Economists, of course, with their wonted narrowness of vision, say that laws forbidding such sacrifice would be "sumptuary," and therefore objectionable. We deny the assertion: the purpose of the needed law is not to restrain expense (*sumptus*), but to prevent the wanton extirpation of creatures lovely, innocent, and often directly useful to mankind. In the joint names of Science and Humanity we demand protection

for the wild birds against the *modiste* and the *plumassier* no less than against the Whitechapel bird-catcher and the Cockney sportsman.

IV. THE INFLUENCE OF HEAT AND LIGHT UPON VEGETATION.

DR. HELLRIEGEL has been engaged for some years in studying the action of heat and light upon the development of plants. His results, which are very important both from a practical and a theoretical point of view, were made the subject of an independent work,* and have also appeared in an abridged form in certain German periodicals.

He lays down the fundamental position that the stock of nutritious matter which is placed at the disposal of a plant is capable of being utilised and assimilated only when a given quantity of heat and light is simultaneously offered. The life of the plant lies within two well-defined limits of temperature. These limits differ not alone for every vegetable species, but for each physiological function.

Near the lower limit of temperature all the vital functions of a plant are effected with extreme sluggishness, but as the heat augments the energy of vegetation increases, and reaches its maximum at a certain degree, which may be called the optimum temperature. If this limit is overstepped the vital actions of the plant become feebler again,—probably by reason of abnormal processes and decompositions in the interior of the cells,—and cease entirely at a third upper limit.

The optimum temperature for the different physiological functions ranges between 68° and 104° F. (20° to 40° C.; temperatures above 122° F. (50° C.) have a destructive action upon the more highly-organised plants.

Light behaves in a manner very similar to heat. In complete darkness no green (chlorophyllaceous) plant can

* Beiträge zu den Naturwissenschaftlichen Grundlagen des Ackerbaues. Braunshweig.

prolong its normal existence. The germinative process alone is effected better in darkness than in the light. If a plant which has passed this stage is completely secluded from light the formation of chlorophyll is prevented, and any which has been previously formed is destroyed. The plant becomes pale, the stem and leaves assume a quite anomalous form, and the amount of total dry matter decreases.

The most important phase of the nutrition of plants, the decomposition of carbon dioxide (carbonic acid) and the assimilation of the carbon in the chlorophyllaceous cells, is purely a function of light,—in other words, it increases or decreases with the increase or decrease of light.

In a faint light the process of assimilation is feeble and tardy; it increases with the intensity of light, and reaches an optimum point, which, however, does not coincide with the maximum of light. Heat and light, together with the rainfall, form that complex factor in fertility which is understood by the terms "weather" and "climate." This factor determines the quantity of crops more frequently, and to a greater degree, than the natural factor known as fertility of the soil, and the artificial factor of manures.

It is generally supposed that the lowest limit at which the majority of our field-plants are capable of germinating is about 39° to 41° F. (4° to 5° C.). Observation, however, proves that this limit lies lower, approaching 32° F. (0° C.).

To decide this point Dr. Hellriegel, in the winter 1871-72, sowed the seeds of eighteen plants which he wished to study in a number of flower-pots. No. 1 was kept at the constant temperature of 8·7° C., No. 2 at 5°, No. 3 at 3°, No. 4 at 2°, and No. 5 at 0° C. The soil and the proportion of water were alike in every case. In this manner the pots were allowed to stand for 55 to 60 days. The temperature of the soil was determined at different times of each day, and the number of seedlings was noted.

At the end of the experiments the young plants and the seeds which had not germinated were washed out of the soil, and more closely examined. The seeds experimented on were winter rye, winter wheat, barley, oats, maize, rape, flax, tares, peas, horse-beans, clover, carrots, cress, and cucumbers. Winter rye was found to require the lowest temperature for germination. It sprouted at 32° F. (0° C.) quite normally, and developed both its seed-leaf and root-germ, though slowly. Winter wheat came next; it germinated at the same temperature, though more slowly than rye. Barley and oats required more heat; they put forth

their seed-leaf at $35\frac{1}{2}^\circ$ F. (2° C.) though the root showed at 32° F. Maize, as might be expected, required the highest temperature among the cereals; it only began to germinate, and that slowly, at $47\frac{1}{2}^\circ$ F. ($8{\cdot}7^\circ$ C.).

Rape germinated at 32° F.; flax at $35\frac{1}{2}^\circ$ F.; tares sprouted well at 32° F.; peas and clover at $35\frac{1}{2}^\circ$ F.; beans and carrots at $37\frac{1}{2}^\circ$ F.; whilst cucumber seeds showed no signs of germination even at $47\frac{1}{2}^\circ$ F.

It must not be supposed that these results throw any light upon the temperatures required for the further development of the different species of plants. Further experiments were made in this direction with barley-seedlings. A series of flower-pots was taken, of which *a* was kept constantly in a water-bath at 50° F. (10° C.), *b* in one at 68° F. (20° C.), *c* in a similar bath at 86° F. (30° C.), *d* in one at 104° F. (40° C.), and *e* stood in a water-bath exposed to the fluctuating temperature of the atmosphere. In each pot were set two barley-seedlings, the soil and the water-supply being of course identical in every case. The experiment was continued from August 9th to November 9th, when the plants were pulled and analysed.

The plants in *e* showed a healthy, equable growth, and a good colour, and were evidently quite normal. Very similar were the plants in *b* (at 68° F.). Those in *a* grew unusually slowly, whilst the plants in *c* grew very rapidly. The former of these two lots, however, were of a deep luxuriant green, whilst the latter were duller and paler in colour. The plants in *d*, exposed to a constant bottom-heat of 104° F., were pale and sickly, and lagged behind in their growth. This temperature had evidently an injurious effect. For barley, therefore, a temperature of 68° F. seemed the optimum point, whilst 50° and 86° F. could not be pronounced hurtful.

Similar experiments were made with the seedlings of other cereals. It was found that wheat, in its first period of growth, requires a considerably higher bottom-heat than rye,—a result which agrees substantially with observation made in the fields in ordinary agricultural practice.

For rye in the first period of growth assimilation was found to be most active at 68° F., for barley 77° F., and for wheat at 86° F.

The question was next raised whether, and if so to what extent, transitory higher temperatures affect the growth of plants injuriously.

The various physiological functions of vegetable life are not all best effected under the same conditions of heat and light, but require unequal quantities of both. Thus the

respiratory process—till lately very frequently overlooked in plant-life—requires the smallest share of heat, and goes on even in the total absence of light. The assimilation of carbon makes higher demands both for heat and light, whilst the formation of certain chemical compounds requires a still more liberal supply of both.

These and other single physiological functions obtain a varying importance for the general life of the plant at its different vital epochs. Hence, as a necessary inference, the entire plant requires at its different stages different quantities of heat and light. As a general rule, as a plant approaches and reaches maturity, the more heat and light it requires. If the maximum intensity of heat and light does not coincide with the last period of the plant's life, but with the epoch of the most active production of leaves, the total growth is checked; the production, and consequently the development of the seed, is retarded.

If in this last period the supply of heat and light is insufficient, the reserve matter which has been accumulated in the leaves does not transmigrate completely to the seeds, but remains to a greater or less extent in the leaves, in the stalks, and in the seed-capsules. Hence the leaves do not wither, but remain green and juicy. In bad cases new shoots are pushed out, and the crop never ripens.

As the intensity of light and heat increases regularly from winter to summer, and reaches its maximum from July to the middle of August, the vegetative times of plants should be so arranged that the epoch of the formation of seed may fall about the end of uly. The seed-times for the different crops are therefore dictated neither by custom nor by economic circumstances, but by natural laws,—the relations of the plant to the earth's annual movements.

It is therefore evident that the productiveness of a country depends not so much on its mean temperature as on the question whether its supply of heat is received at the right time. It has been demonstrated by other observers, proceeding by the statistical method, that, other things being equal, the wheat-harvest in England is simply a function of the mean temperature of the months of July and August, unusual heat after harvest or in winter being, as far as corn-crops are concerned, simply wasted.

Dr. Hellriegel illustrates his conclusions as to the coincidences of the epoch of maximum heat with that of the formation of seeds by the following experiments:—He sowed barley, under otherwise identical conditions, on April 21st, May 28th, June 28th, August 2nd, and September 1st.

The first crop became ripe in 88 days, the second prematurely ripe in 87 (the maximum heat and light happening too early, before the plant was sufficiently mature); the third became imperfectly ripe in 150, the fourth in 200, and the last in 240 days!

In another series of experiments Hellriegel examines the comparative action of direct and of diffused light upon plants. He points out certain disadvantages to which plants cultivated in glass-houses are exposed. The motion of the air in an enclosed house is less perfect than outside (though it must be admitted that in England generally the movements of the air are far too perfect for vegetation). Another—and in our opinion far more important—difficulty is that even the best glass is not absolutely permeable to air and light, a certain portion being reflected or absorbed. Within the house a further portion of the light which has entered is absorbed by dark objects (plants, pots, soil, &c.), and converted into heat which does not radiate out at the same rate as it is produced. Thus the proportion between light and heat is different within from without: we hesitate, however, to endorse the author's opinion that this difference in proportion is always disadvantageous to plant-life. The proportion existing in the open air varies exceedingly, and there are few conditions more destructive to plant-life than one which prevails very commonly during the easterly winds of spring, when intense light is combined with a low temperature. It has been found that the blighting effect of such weather may be counteracted either by increasing the heat or by keeping the plants temporarily in the dark.

From Hellriegel's experiments it appears that from two sets of barley-plants, equal in number, those cultivated in direct sunlight in the open air gave 4282 m.grms. of grain, whilst a similar number grown in diffused light only yielded merely 873 m.grms.

A further subject investigated was the development of plants in light of different colours. The author's results by no means confirm those with which General Pleasanton astonished the world a few years ago.

It is a known fact that white light, after it has passed through our atmosphere, has not always the same qualitative composition. The author did not attempt to experiment with perfectly homogeneous, monochromatic light, but selected illuminations in which rays of a certain given wavelength predominated, others being more or less completely excluded. For this purpose he used very large roomy bells of coloured glass, which were kept regularly ventilated by

means of a petroleum lamp. Under similar bells of coloured glass, plants had been found capable of passing through their entire vital cycle without displaying any anomalous phenomena or yielding unusually small crops.

To determine the influence of different colours of light two bells were selected, the one of blue and the other of yellow glass, both of a medium shade.

The blue glass, coloured with cobalt,—as was found on examination of its spectrum,—transmitted, in addition to the blue and violet rays, the red and the green, apparently unhindered, the orange and yellow only being extinguished.

The yellow glass, coloured with carbon, transmitted all the rays except the blue and violet. The absolute intensity of the light was manifestly greater under the yellow bell than under the blue.

The barley-plants under both bloomed normally, formed good, perfect ears, and ripened finally in the ordinary manner without being distinguishable from other plants placed for comparison under a colourless bell.

The weight of all parts of the plants above the surface, when dried, was from the yellow bell 5291 m.grms., and from the blue bell 4431.

Two new pots of equal size were then planted with sprouting barleycorns, and placed under coloured bells. The blue bell was of the same colour as in the former experiment, whilst the yellow bell was darker, and the absolute brightness under it was small. The violet ray was quite extinguished, and the blue nearly so. Both plants showed nothing anomalous in their growth which might be ascribed to the specific action of the coloured light. They seemed merely like plants which had been partially withdrawn from the direct sunshine. There was no difference between the two, save that the plant under the yellow bell, which was the darker of the two, was the earlier in showing signs of weakness. The plant from the yellow bell gave 2·5725 m.grms. of dry substance, and that from the blue bell 2·7990.

It thus appears that plants are not very sensitive to moderate changes in the qualitative composition of the sunlight to which they are exposed.

It need scarcely be added that the wonderful effects which have been ascribed to the blue ray, or rather to light passing through ordinary cobalt-blue glass, cannot be considered as scientifically demonstrated.

V. THE HUMAN FACE.

By D. Y. Cliff.

When men first detected that the voice, sight, hearing, smell, and taste were all situated in and emanated from the head, he looked upon it, and its contours and proportions became to him comparable and beautiful; he said, grandly, "It is the image of God!" How much does the rest of the body owe to carnal passions and "pride of might?" Admiration and appreciation have surely played a large part in our development. The intellect animal looks to the face—has it an idea of beauty? Do we recognise "beauty" in the brute creation from long inbred association, or have they themselves had a hand (or an eye) in it? The fact that it contains scarcely anything to cringe or terrify us, at first sight, would seem to prove this inbred familiarity. We find nature to be born *in* and *of* ourselves. There are more dangers in the artificial productions of Man than in the structures of Nature. The eye reaches further than the weapon; and it is easier to fall from a window than from a tree.

Some say the national face does not change, its apparent differences being the result of fashion—costume, hat, hair, &c. For my part it seems that the history of each age is painted on the faces of its people. Parents would seem generally to anticipate (or form) in fancy the realities of their offspring—probably unknowingly. I have, on several occasions, been struck by odd faces here and there which belonged to a past age. Some will, of course, smile at this. Once, *e.g.*, at a sham parliament in a Cheshire town, I saw an exact reproduction of the face (as generally represented) of the Georgian epoch of English history. The high cheeks, the ruddy skin, particularly the wide low forehead with its distinctive depression (almost) in the middle of the forehead where the head curves downwards, the broad face, the peculiar "look," &c."

The face of Charles I. suggests his artistic taste, his theological thoughtfulness (so general then), and a proud indifference to vulgar rowdyism. He was to his age what "Farmer George" was to his, and the Prince of Wales is to his—types thereof—the men thereof bearing one of its varied educations, but the same generally under each disguise.

It would be a long subject to discuss the features of the different ages in English history and speculate upon them, and perhaps foreign to this journal. It is this feeling we have, this recognition of a fact, that hurts our fancies to see an ugly artist, a handsome slave, and sometimes to wonder at the beautiful eyes some of our domestic animals possess. We find an innate pleasure in gazing on a handsome face.

The above causes, no doubt, have lent a diversity to the face of woman, which reacts on the man. The favourite type is "married up" in excess of others, and effectually impressed on the race. To this we may trace, probably, the widely diverged races of men, the Mongol, the Negro, the European, &c. The transmission of the family likeness, paternally and maternally, is interesting to reflex on. That was a scandalous remark, to me, I read, I think, in your journal, about the passing admirations of a mother being stamped on her children's faces. Why is not the husband, the favourite brother, the sister, the mother, father, &c., oftener reproduced, if that be the case—with the double chance? It is remarkable, though, that the eldest child seems very often to retain the strongest family likeness. But the strong likeness of brothers and sisters is an argument against it. Perhaps this is largely owing to their catching each other's expressions of countenance; and this again explaining why the "younger end" often differ so decidedly from their elders—lack of association. This same thing applies to nations; hence the force of the child's remark, "all Frenchmen seem to grin alike." A national contortion.

One would like to have seen the face of the Persians who made it part of their education to "speak the truth." We could have seen it! *Was* the Spartan stern in aspect who lived for his country's good? Was Deborah a Jewess in her look? Can we not read Byron's poetry in his face, and the heaviness of pondering judgments in Hallam's? Do you doubt, as you look at Nero's face, that he could fiddle whilst Rome burnt? And so on; a man's mind shines out of his countenance, the face in repose, or unanimated, is the generality of that individual's mind. And so we turn to look on the faces around us to-day. Are not the majority mere livers—mere nonentities? These will not remain in history, but they will form the nation's destiny!

Our souls were filled with sadness when we found inanity behind a lovely face. Nature lied to us! Do the choice minority conquer in the long run? It is one long fight.

VI. THE FUNCTIONS OF THE CEREBRUM.

THE question is debated among physiologists whether or not the grey cortical substance of the cerebrum presents distinct localisation of functions, so that the senses of sight and hearing and the action of the various groups of voluntary muscles may be referred to strictly limited portions of this stratum. The affirmative view is chiefly advocated by Professor Munk.

On the other hand, Professor H. Goltz, of the University of Strassburg, is led by his observations and experiments to deny every special limitation of the centres of certain groups of functions.

In order to prove that small, limited portions of the cortical substance are not the centres of given activities, muscular and sensitive, Goltz removed portions of the anterior portion of the brain, or of the occipital lobe, in certain dogs, sometimes on one side only and in other cases on both. He then studied the phenomena evinced by the animals months afterwards. In judging of the results he is guided merely by the minimum of the disturbances which occur after the operations in question, and regards all manifestations which appear in some of the subjects but not in others as mere collateral disturbances which throw no light on the functions of the parts removed. The operations, it must be remembered, affected not merely the cortical layer, but, to some extent, the white matter.

We extract from "Pflüger's Archiv für Physiologie" a summary of the chief results.

We have to distinguish animals which had undergone an extensive bilateral removal of the anterior lobe (*a*) from those (*b*) in which a considerable part of the occipital lobe had been extirpated. The following differences appeared:

1. A dog (*a*) retains sensation in all parts of his body. It is even demonstrable that, under certain circumstances, his sense of feeling is delicate. But he touches awkwardly, and treads (or attempts to tread) in vacant space. No muscle of his body is lamed or paralysed. He can move all his muscles at will, but his movements are clumsy and helpless. He is especially awkward in taking food. He does not understand how to hold fast a bone with his fore paws. He does not hesitate to leap from a height, but the movement is awkward.

An intensification of reflex excitability is regularly manifested.

There is very often a change in his moral character; he becomes more irritable and quarrelsome. He gives, invariably, proofs of a general excitement. He is impatient, distracted, and runs restlessly about.

The sense perceptions are not much enfeebled.

The intelligence is always moderately reduced.

2. A dog of the class *b* has his sense of touch undisturbed, and feels well. He does not step on vacancy.

He can not only use all the muscles of his body at pleasure, but these movements take place approximately with the same dexterity as in a dog in his normal condition. He displays no awkwardness in eating, and knows how to hold bones fast with his paws. He hesitates at leaping down even from a trifling height.

His reflex irritability is not increased.

If previously violent he becomes good natured after removal of the occipital lobes. He is free from excitement, and both in his bearing and movements he appears quiet, discreet, and tranquil.

He suffers from a general and well-marked weakness of perception.

His intelligence is profoundly reduced.

Professor Goltz further adds that dogs of the class *a* become and remain meagre, whilst those of the class *b* invariably grow fat.

According to these results, there cannot, as a critic in the "Naturforscher" observes, remain the slightest doubt that a dog which has lost the posterior lobes differs in very essential points from one which has undergone a corresponding operation in the anterior portion of the brain. Hence, even in the opinion of Professor Goltz, the lobes of the cerebrum have not one and the same signification. It remains, however, an open question in how far the pathological phenomena above described are dependent on the extirpation of the grey substance or on the accompanying injury to the white matter. The question cannot be decided experimentally, since it is not possible entirely to remove the grey matter without interfering with the white substance. Even if the latter is not mechanically injured, its nutrition is so compromised by the removal of the cortical layer that we cannot possibly suppose its normal action to be unimpaired. All experiments which aim at determining the functions of the grey substance are open to this source of error.

VII. THE LIGHT OF FIRE-FLIES.

THE light emitted by luminous insects has often been the subject of observation and experiment. Recently MM. Aubert and Dubois have obtained some highly interesting results in this direction with a Pyrophorus, which arrived in a living state at Havre in a cargo of wood.

The author first submitted the light of the insect to a spectroscopic examination.

The spectroscope used was an ordinary one with a flint-glass prism of high refractive power and with a micrometer. The insect was fixed opposite the slit, which was illuminated by one of the luminous organs of the prothorax. It is, of course, well known to many of our readers that the Pyrophori have three light-organs ; one on the ventral side and the two others on the upper part of the prothorax. The latter, which are always visible, have been used in the experiments in question. The light which they throw off takes a divergent direction to each side of the animal, so that one and the same point cannot be simultaneously illuminated by both organs. Only one of them was, therefore, utilised. The surface to be illuminated was placed perpendicularly to the principal direction of the rays, which make an angle of about 45° with the plane of symmetry of the insect.

The spectrum of the light is very beautiful, but continuous, having neither dark nor brilliant rays.

The spectrum occupied about 75 divisions of the micrometer, extending on the red side up to the middle of the interval which separates the rays A and B in the solar spectrum. On the blue side it reaches a little beyond the ray F.

When the intensity of the light varies its composition changes also in a remarkable manner. When the brightness decreases the red and the range disappear completely, and the spectrum consists merely of the green with a little yellow and blue. The green rays remain longest. The reverse takes place when the insect begins to emit light. The green appears first ; then the spectrum extends a little on the blue side and considerably towards the red. The least refrangible rays are, therefore, the last to be emitted. No other source of light is known to behave in a similar manner.

The only case at all similar is that of strontium sulphide, rendered phosphorescent by light and by an increasing temperature. As the temperature rises the less refrangible rays appear in the spectrum, but, at the same time, according to E. Becquerel, the more refrangible rays disappear.

On examining the luminous organs with a little attention, it is found that when the light begins to appear the central and interior portion alone is luminous. It is only when the light becomes very brilliant that it reaches the peripheric stratum in which Robin and Laboulbène have proved the presence of a number of fine oily drops. These savants think that the peripheric stratum does not produce the light, and merely reflects that produced by the central portion of the organ. However this may be, it is curious to remark that the red rays do not appear until this peripheric layer becomes luminous.

The authors have next examined the photo-chemical, or, as the common expression is, the photographic power of the light. Although the spectrum extends but little towards the violet they tried its action upon plates rendered sensitive with the gelatino-bromide of silver. After some fruitless attempts they arrived at satisfactory results. A bit of lace-work of blackened paper was placed before the sensitive plate, which was then exposed to the light of one of the luminous organs placed distinctly above the middle of the design. The other organ sent its rays almost parallel to the plate, which it illuminated a little on one side. The insect was placed at the distance of 0·02 metre from the plate.

By reason of this proximity the illuminated field was of small extent, and scarcely went beyond the borders of the design, save on the side illuminated by the second organ. In order to obtain a decisive result the plate was exposed for an hour, but the action was so intense that a much shorter exposure would evidently have been sufficient. Five minutes were afterwards found sufficient, and the authors think that they could have obtained results in a still shorter time if the death of the specimen had not put an end to the experiments.

The photographs show that the light of the Pyrophorus has a very intense chemical action, especially if we consider that these organs, though brilliant, emit but a very small quantity of light, as was proved by photometric experiments.

The light of the Pyrophorus renders calcium sulphide phosphorescent after five minutes' exposure. The phos-

phorescence is faint, but distinct, and lasts for some time.

On exposure to this light eosine and uranium nitrate become distinctly fluorescent.

No result was obtained with quinine sulphate or an ethereal solution of chlorophyll.

The authors conducted their researches in the Laboratory of Maritine Physiology at Havre, a genuine aquarium; and their results have been laid before the Academy of Sciences.

VIII. NOTES ON *COCCINELLA DISPAR*

(COMMON LADYBIRD).

By J. W. SLATER.

THE abundance of this insect during the past summer has given opportunity for a few observations. There have been three successive broods, unless, which is scarcely probable, the adult specimens of the second brood remained alive and active for some three weeks after copulating and depositing their eggs.

These insects seem to be protected by the smell which they give off if bruised, and which to human nostrils is very disagreeable, and of a kind to indicate an equally offensive taste. A single pupa, too, when adhering to the surface of a leaf, has a rather close resemblance to the excrement of a small bird. But being thus, as may be suspected, doubly protected, it is curious that these insects select two very different kinds of situations where to pass their pupa stage. Upon a row of black-currant bushes, where my observations were chiefly made, numbers of pupæ were to be found singly, on the upper surface of the leaves, each generally near a rib or in the depression at the insertion of the footstalk. But about an equal number of the pupæ were to be found on the under surface of the leaves. Here they were collected in groups of from three to eight, and were secured by a few silk threads.

Whether these threads had been spun by the larvæ in the

act of pupation, or whether they were the work of some caterpillar which the ladybirds had devoured, I am not sure.

Against one enemy the pupæ are not protected—the larvæ of their own species. In fact this species—doubtless its congeners also—is of cannibal habits. When a larva in its travels encounters a pupa, moored by its posterior extremity to the leaf, and unable either to fight or flee, it at once seizes the booty from behind. I watched several such cases through a lens, and saw distinctly the mandibles of the larva plunged into the body of its victim and working from side to side. The pupa which is thus being devoured at times raises its head, or moves it from side to side, until its life is extinct. Mr. Billups, one of our most observant entomologists, informs me that he has witnessed similar cases. But as his cannibal specimens were in captivity, he suspected that possibly they might be driven to such an unnatural diet from the exhaustion of the supply of their legitimate prey—Aphides. I am sorry that I cannot give the ladybirds the benefit of this doubt. I observed cases of cannibalism not merely in a small glass box in which I had placed some larvæ, but on the currant bushes where Aphides were swarming. Hence I fear that the *Coccinellæ* are deliberate and habitual cannibals. It is needless to state that this practice must seriously compromise the multiplication of the species, and must especially limit its usefulness as an Aphis-destroyer. Whether this form of cannibalism tends to eliminate the strongest or the weakest members of the species I am unable to say. The destruction falls chiefly upon the progeny of those ladybirds which in each brood are the earliest to deposit their eggs. If such eggs, as I suspect, give rise to the finest specimens, we have here a phenomenon which strongly resembles a survival of the unfittest. I may add that I have never seen a mature *Coccinella* attacking any of the pupæ of its species. This cannot be from mere want of appetite or indifference to food, since the mature specimens prey upon plant-lice no less eagerly than do the larvæ.

When the mature insect first throws off the pupa-skin, its elytra and the upper surface generally are semi-transparent, and of an exceedingly pale amber colour. The design on the thorax is to be seen, but there is no trace of the black spots which afterwards appear, one on each elytron. These are gradually formed in the course of a couple of hours. I have not found that the presence or absence of light made any difference in this process. It would seem, therefore, that there is deposited at the spots in question

not a ready-formed colouring-matter, but what is known among tinctorial chemists as a chromogen,—a substance capable of yielding a colour under some external influence, —here doubtless the oxygen of the atmosphere. To test this supposition I placed leaves to which pupæ were attached in gaseous mixtures free from oxygen, but the specimens died, as I had feared might happen.

I am sorry at having to exhibit an insect so useful to man, and which shares with Cock-Robin the honour of figuring in the nursery-rhymes of most nations, in the odious character of a cannibal. Would that some of our enemies—such as the house-fly, the wireworm, the crane-fly, &c.—would develop the same habit!

IX. THE LUMINOSITY OF *LUCIOLA ITALICA*.

THIS insect, belonging to the family of the Lampyridæ, is very abundant in the neighbourhood of Bologna. S. C. Emery has taken the opportunity of submitting them to a thorough examination, both as regards the anatomical structure of their luminous organs and as to the chemico-physiological process upon which the production and emission of light depend. His observations were much interfered with by the unfavourable character of the weather during the summer of 1883, so that only the anatomical part of his researches can be regarded as completed.

According to his observations, as recorded in the "Zeitschrift für Wissenschaftliche Zoologie," the luminous organs consist of continuous plates, consisting of single lobes in which the terminal ramifications of the tracheæ, the tracheal capillaries, open without communicating with each other.

The male Luciolæ give out light in two distinct modes: in the night, when they are brisk and fly about, the light increases and decreases in short regular intervals, so that it seems to twinkle. If one of them is caught flying, or disturbed in its rest by day, it shines less than at the maximum of its intensity when on the wing, but without intermission. It is remarked, however, that the luminous plates do not

shine uniformly over their whole extent, but that sometimes one spot and sometimes another glows more strongly. If such a specimen is examined under the microscope we perceive, on a dark back-ground, bright luminous rings, which are not, however, uniformly brilliant, but display certain more intense points which flash up and again disappear, or continue to shine on faintly for a time, reappearing afterwards in full splendour. These changes take place without any regular succession.

Signor Emery concludes that the luminous combustion takes place on the surface of the parenchymal cells, but not in their substance. These cells probably secrete the luminiferous matter which is taken up by the terminal tracheal cells, and is burnt by means of the oxygen encountered in the tracheal capillaries. Emery does not consider that the emission of light is a sexual attraction for the females, which are rarer. He suspects that it rather serves to deter insectivorous nocturnal animals.

X. THE INFLUENCE OF MAGNETISM ON THE DEVELOPMENT OF THE EMBRYO.

PROF. CARLO MAGGIORANI has recently read an account of some experiments on this subject before the Academy dei Lincei.

During the process of artificial incubation the author exposed a number of eggs to the influence of powerful magnets. A similar set of eggs, being hatched in the same manner, but kept away from all magnetic action, served as a check. Cases of arrested development were four times more numerous in the first group than in the second. Analogous facts had been previously published in the "Natura" (Florence, 1878). Microscopic examination showed that the sterilisation of these germs was probably due to an intense vascularisation of the yolk-sac.

After the birth of the chickens this increased mortality continued, deaths being three times more numerous in the magnetised group. All the counter-test chickens reached

their full development, whilst of the 114 of the first group 60 presented notable imperfections. Their movements were also abnormal. There were three cases of paralysis and two of contractions.

Six of these chickens arrived at maturity. Of these, two were cocks of a splendid stature, and endowed with an insatiable reproductive appetite. With the four pullets it was quite the contrary. One of them never laid at all, and the three others generally produced merely minute eggs (the heaviest weighing only 30 grms.), without yolks, without germinal spot, and, in a word, sterile.

The magnetic influence upon the embryo is therefore evident, and its action upon the structure and the functions of the germ is still manifest when the latter is arrived at maturity.

May we not, to explain this effect of the magnets, suppose an interference between the magnetic vibrations and the heat vibrations which animate the molecules of the fecundated germ, and impel them towards a new condition of organic equilibrium. This influence generally prevents, and more rarely retards, the development of the embryos (hypertrophy in the two cocks, and atrophy in the four hens), and, as interference implies analogy, may we not infer that the vibrations which impel the germ towards its development are analogous to the magnetic vibrations?

ANALYSES OF BOOKS.

An Introduction to Mental Philosophy on the Inductive Method. With numerous Examination-Papers in Mental Science set in the different Examinations in the London University. By J. D. Morell, A.M., LL.D. London: W. Stewart and Co.

This work, as appears from the very title, is written from a point of view which does not commend itself to our approval. This is shown beyond all doubt in the last paragraph of the Preface. Dr. Morell there writes:—"To render this edition more useful as an Examination Text-book I have asked the aid of a London University graduate, and an experienced tutor, to eliminate from the text what may seem unnecessary or confusing to the student, and to throw the whole into the form suited to the requirements of the London B.A. and other examinations in which psychology is taken as a subject. And to render the book still more useful to students a large number of Examination-Papers have been appended, which papers could not possibly be answered from the contents of any one book, but as many of which could be dealt with directly, or by inference, from this volume as from any other yet published."

Now an "Examination Text-book," whatever ability it may otherwise evince, can only be regarded as the outcome of a radically vicious system, in the main peculiar to England, and the chief cause why—with fair natural capacities, and with a prodigal expenditure of time, labour, and money—we occupy a position in Science inferior to that of certain rival nations.

As regards not a few of the questions in the "Examination-Papers" it might be, for a man of abundant leisure, a curious employment to speculate on the state of mind of the persons putting these questions, on the answers they might expect, and on those they actually received. But for such musings this is not the place.

The author, it will be seen, treats of mental philosophy as a natural science, to be studied on the inductive method. In the very outset of the chapter dealing with the "facts of psychology" it will be seen that Dr Morell's subject in not *general*, but *human*, psychology. He does not begin, *e.g.*, with the simplest manifestations of mind, such as we find them in the lower animals, and trace them upwards to their highest complexity as shown in man, thus following the plan which in physiology has proved so fruitful in important results. There may, perhaps, be grounds

for confining psychological inquiries to our own species. Thus it is impossssible for us to look inwards into the mind of the ape, the dog, or the ant, as we do into our own. Nevertheless we incline to the belief that the psychology of the future must ultimately take the new track to which we have referred.

The author recognises a *vital force*, judiciously declining to pronounce, however, whether it is a form of energy or a power *sui generis*. His words are: "What this vital force consists of —whether it be a chemical agency, or magnetic agency, or spiritual agency, or something quite distinct from all the physical or mental forces, and peculiar to organised living bodies—we do not presume to determine." The reader might here feel tempted to ask whether Dr. Morell recognises any other category of agencies distinct both from the physical and the spiritual?

But this vital force is not the only one which the author finds in organised living beings as distinguished from inorganic objects. He admits also a *nerve force* and a *force of mind*. These three agencies he considers as correlated and mutually convertible, yet not identical. We are not sure, however, whether he is not too much inclined to draw sharp distinctions, where persons trained in the biological world see merely a continuous, gradually changing series. At least he does not sufficiently guard himself against being so understood. Thus he states that in the inorganic world there are "no individualities but simple fragments." Yet a crystal is an individual, and so also is one of the pseudo-organisms of G. Fournier. "The tendency to individualisation," he writes, "only becomes perfect in the animal." But here is no sharp boundary-line. There are animals which may, like plants, be multiplied by cuttings.

We are glad to find the author admitting (p. 29) that the division between the vital and the mental is, "after all, arbitrary as far as the real character of the nerve-force which is active in both cases is concerned."

In the third chapter the doctrine of "latency" is very clearly expounded. Heredity is here also fully admitted. He writes:— "The human mind is not a *tabula rasa* upon which experience has to write all the characters. Every individual has his own distinctive type; brings with him into the world mental tendencies and characteristics, derived from his parents and ancestors; possesses vital substrata which operate prior to consciousness altogether; exhibits the working of inward teleological forces which bear the stamp of individuality before the conscious reason is awakened, and impress that stamp thus early upon an organism framed to correspond exactly to the soul of which it is the instrument and the habitation." We note the expression "the conscious reason is *awakened*." Would not "developed" have been a happier expression?

In the fourth chapter, in which Dr. Morell discusses "primordial mental activity and consciousness," we are glad to find him

rejecting certain errors concerning "instinct." He writes:—"It is not an uncommon idea to contrast instinct and reason, as though they were opposite in their nature and the one excluded the other. The real fact of the case is that, so far from being opposites, they are fundamentally identical. Instinct is reason, but reason in its undeveloped, semi-unconscious, and wholly voluntary form." He goes on, however:—"The primordial instincts we have just referred to (*e.g.*, the tendency of the new-born baby to suck) are the first efforts of reason to awaken from its slumber, and to commence a new and conscious life in connection with the higher organism which *human nature* presents." Has reason then existed before the organism, and has it passed an unconscious life in connection with some lower organism?

In his fifth chapter the author reviews the materialistic hypothesis, to which he opposes the two following arguments:—

"That no one knows what matter is, so that when we have succeeded in reducing mind to matter we are really no nearer to any valid solution of the difficulty of the case than we were before. Matter, after all, may perhaps be reducible to force (energy), and force to spirit, as its source and spring."

To this contention the materialist might reply that an analysis by which the two supposed substantive entities, mind and matter, should be reduced into one, would be a distinct gain, even if the remaining one were still an unknown quantity. To take a parallel case, if the three halogens, chlorine, bromine, and iodine, were all found to be reducible to one, chemists would experience lively satisfaction, even though the origin and ultimate nature of that one should remain inscrutable.

The second argument is much more weighty:—"That the material forces from which mind is supposed to emanate are, as far as all our experience goes, uniform and constant in their operations, while in every single mind we have a separate and distinct individuality. How any combination of chemical, electrical, or other physical forces, passing through any conceivable kind of organic instrumentality, could result in the infinite variations of human individuality is quite beyond our power of conception, and is alone sufficient to stamp Materialism as inadequate to sum up the facts of the case intelligibly into a scientific formula."

Another theory brought forward—we remark in passing that the author does not, in some cases at least, distinguish between "hypothesis" and "theory"—is that which regards mind as a "special manifestation of the Absolute thought." This, also, the author sets aside as incapable of accounting for the facts of individuality.

The ordinary dualistic theory views mind and body as "two wholly distinct existences with a temporary and partial connection, but still carrying on their respective functions quite independently of each other." This supposition, also, is inadequate

Dr. Morell himself inclines to the "doctrine of Individualism, according to which every man [and if every man, why not every animal?] is made up of two elements, material and spiritual, which completely inter-penetrate each other. Body and mind here stand to each other in the relation of matter and form."

This doctrine, of course, does not lend itself to the familiar conception that the body is the house or dwelling of the soul. Nor is it easy to see how it, rather than the materialist view, accounts for the vast variety in individuals.

We regret that we cannot, for the present at least, pursue further our examination of this interesting work. Within the compass selected, and under the conditions which the author has set for himself, *viz.*, of producing an examinational text-book, and of dealing with the human mind out of connection with the minds of the lower animals, it may be pronounced a most valuable treatise.

On Insanity and Nervous Disorders peculiar to Women in some of their Medical and Medico-Legal Aspects. By THOMAS MORE-MADDEN, M.D., F.R.C.S.E. Dublin: Fannin and Co.

THIS small work raises some great and grave questions. There is, firstly, the subject of our lunacy laws and the desirability of their reform. At present it appears that any two medical men, not necessarily of eminence or long experience, not necessarily such as have made a special study of brain diseases, may by their certificate—which is practically a *lettre de cachet*—doom any man or woman to indefinite confinement in a lunatic asylum. Of this a very painful instance has been lately recorded in the columns of "Light." The victim in this case was perhaps slightly eccentric, but he was perfectly capable of looking after his own affairs, and was neither a source of danger to himself nor to the public. Yet the lunacy laws of England enabled an unfaithful wife to have him incarcerated. He was, indeed, soon released, but in the meantime the woman had disposed of all his property at a ruinous sacrifice and gone abroad! Dr. More-Madden proposes that in future "certificates of insanity should be given only by specially appointed Medical Inspectors of Lunatics; that private asylums should be abolished as such; and that all patients in asylums should be treated by extern or visiting physicians."

Another serious matter here touched upon is the increase of insanity in "this our highly-favoured country." In England and Wales it appears that within the last thirty-five years the number of registered lunatics has risen from 1 in 800 to 1 in 352. In

Scotland and Ireland the increase is similarly alarming. This fact is even more serious than it appears at first glance. If we find a certain number of deaths recorded as having happened in a battle, an explosion, or a railway collision, we know at once that the amount of the persons wounded or mutilated will be, under average circumstances, much greater. Just so here: if out of every 352 persons there is one decided lunatic, we may be quite sure that there will be two or three persons weak-minded, given to delusions, or easily led by impostors and quacks of all kinds. Is this not so?

Dr. More-Madden does not enter into the general causes of this increase of insanity. But if we ask ourselves in what has there been the greatest change during the last thirty-five years, there can be but one answer—the increase of worry and anxiety. Part of this is due to intensified competition in trades and professions; part to the examinational Anglo-Chinese system of education which we inflict upon the young, the mischief of which appears chiefly in after-life, or in the next generation.

Dr. More-Madden notes, as an especially alarming feature of the times, the increase of female lunatics. "Formerly insanity was more frequent in the male sex, who, from their habits and occupations, were more exposed to the exciting causes of mental disease; now, on the contrary, the increase of lunacy is even more marked in women than in men."

Among the causes of this change he enumerates "the misdirected or neglected mental and moral training too prevalent in the education of female youth [May we not add the foolish disposition of the heads of boarding-schools to consider health as something 'rude' and 'vulgar'?]; secondly, the undue stimulation of the reproductive functions; and thirdly, the general and increasing tendency to alcoholism in women as well as in men." This alcoholism, we must not forget, is one of the by-products of worry. But there is more to follow:—"Now-a-days women are not only liable to those special causes of nervous disorders which arise from utero-ovarian irritation, but in too many cases they voluntarily expose themselves to all the accidental causes of insanity to which men alone were formerly subject. This is one result of that hopeless contest with Nature in which they are engaged who seek to unsex themselves by assuming all those masculine privileges and modes of life which are too dearly purchased at the expense of that increased tendency to cerebro-nervous disorder by which, in such cases, outraged Nature avenges her violated laws." Too true!

Vaccination. By ALEXANDER WHEELER. London: E. W. Allen.

THR Anti-vaccinationists, like "anti" people generally, cannot be accused of inactivity. Although some prophets of their own have suffered in their persons and their families from the present epidemic, they by no means relax in their efforts. The author of the present pamphlet spends a very large proportion of his space in endeavouring to prove that smallpox is not "the most destructive or terrible English disease." He writes:—"The Committee (Parliamentary) of 1871 tell us that it was the most terrible of diseases." But if we turn to the very words of the Committee, as quoted by himself on the first page of his pamphlet, we read—"Smallpox is one of the most terrible and destructive of diseases." This seems to us a very different proposition from the one which Mr. Wheeler undertakes to refute. He tells us that "the years of greatest mortality are those of the least extension of smallpox," and he complains that "the exhibition of this fact has stupidly led some to charge us with fondness for smallpox." But supposing this is true,—supposing that during epidemics of smallpox the gross mortality is greatest, and that when it is absent such mortality is least,—we submit that this is nothing to the purpose. It can prove nothing as to the efficacy or inefficacy of vaccination, and is therefore altogether out of place.

We must further remind him that the terribleness of smallpox cannot be measured by death-rates. We have no statistics of blindness and disfigurement—the former certainly an evil worse than death, both to the individual affected and the community. Nor is disfigurement a trifling evil. We speak advisedly when we say that a pitted face is no trifling hindrance to persons of either sex in quest of employment. Again, an attack of smallpox not merely causes the patient himself to lose his situation, but it has often the same effect on other inmates of the house. Surely, in face of such indisputable facts, smallpox may well be called one of the most "terrible diseases," and whether the years of least smallpox have more deaths than the years of most smallpox or not is a somewhat frivolous question.

We must also take exception to the following:—"Till the rite (vaccination) is in abeyance we cannot tell certainly if we cannot control smallpox by sanitation equally with other diseases." The facts of the case surely prove that we cannot. The author contends that smallpox is little changed. He writes "that smallpox has decreased in prevalence, but that is a feature common to it and other diseases; and that other diseases have much exceeded it in severity, and yet also in decline, in consequence of sanitation." Well, then, if vaccination *plus* sanitation has

effected but a relatively small decline in variola, will a greater decline be effected by sanitation alone?

We cannot believe Mr. Wheeler when he says that the absurd trust in the Jennerian rite leads to "recklessness and foolish exposure." Our observation tells us that the vaccinated and the unvaccinated alike shun any person whom they suspect of having been in contact with a smallpox patient, or of coming from a house where the disease exists or has lately existed. It seems to us that most people err rather by exaggerated caution than by over confidence.

We think that the fairest way of ascertaining the value of vaccination as a prophylactic would be for the present agitation to be suspended. If the entire community were duly vaccinated, and if smallpox epidemics still occurred, we should then be warranted in questioning the value of the "rite." We fear the basis of the anti-vaccination "movement" is not medical, but political. There are people, we fear, who consider themselves entitled to cherish diseases if they feel so inclined, and who regard vaccination, however efficacious, as an inroad on their "liberties."

Proceedings of the Bristol Naturalists' Society. New Series, Vol. IV., Part 2 (1883-4). Bristol: James Fawn and Son.

This issue contains a continuation of Mr. A. E. Hudd's Catalogue of the Lepidoptera of the Bristol District. Here we find mention of the disappearance of *Solenobia pomonæ*, formerly plentiful. It appears that hundreds of specimens bred by the author, by Mr. Harding, and Mr. Vaughan were all apterous females, not a single male having appeared during several years. *Depressaria pallorella*, formerly common near Bristol, has become scarce. Of *Œcophora pseudospretella* we find it recorded that Mr. Vaughan bred a series of specimens from a wax-candle—a fact which opens up some difficult questions in chemical physiology.

The butterflies of the Bristol district—55 species—include all those recorded by Mr. Barrett for Norfolk, and in addition *P. daplidice*, *L. sibylla*, *L. arion*, *L. adonis*, *N. lucina*, and *H. comma*. Of the Nocturni, Bristol has 73 species as against 74 in Norfolk, and of Noctuæ 215 against 225. No fewer than 35 of the Norfolk Noctuæ have not been seen in the Bristol district, which, on the other hand, has 27 species not recorded by Mr. Barrett. The total number of species of Lepidoptera recorded for Yorkshire is 1341, for the Bristol District 1310, and for Norfolk 1246.

Mr. James W. White contributes a paper on the "Flora of the Avon Bed." A disused limestone quarry had been filled up with matter dredged from the bed of the Avon and the floor of the docks. On this rubbish there sprung up a great variety of plants, some of which had formerly been known to grow in the Avon Valley, but which had become extinct. The author concludes that these plants were due to seeds which had been buried in and had been dredged up with the mud of the Avon.

"Report on Wells sunk at Locking, Somerset, to test the Alleged Power of the Divining Rod," by Prof. W. J. Sollas, D.Sc. This paper is reprinted, with additions, from the "Journal of the Society for Psychical Research." The conclusions of the paper are adverse to the pretensions of the rhabdomant, or "dowser." This man maintained that at the critical moment the dowsing-rod turned of itself, without any pressure being exerted by the fingers. But both Prof. Sollas and Dr. Burder are positive that every time the rod turned they discovered a corresponding movement in the fingers of the dowser.

Mr. Cedric Bucknall continues his Catalogue of the Fungi of the Bristol District, and Mr. J. W. White resumes the Flora of the Bristol Coal-field.

Twelfth Annual Report of the United States Geological and Geographical Survey of the Territories. A Report of Progress of the Exploration in Wyoming and Idaho, for the Year 1878. Part II. By F. V. HAYDEN, United States Geologist. Washington: Government Printing Office.

THIS goodly volume contains, in the first place, an account of the Geology of the Yellowstone National Park. This tract of land, which is for ever set apart for the benefit of the public, and guaranteed against all encroachment, is 55 by 65 miles across. The entire area is from 6000 feet or more above the sea-level. Hence, as might be expected, the climate is rigorous, not a single month of the year being free from frost. Its geological features, both in form and colour, attract the wonder even of non-scientific men, and its hot springs and geysers are absolutely unequalled.

These geysers form the subject of a special report, by Dr. A. C. Peale, which occupies the greater portion of the volume. Of the geysers three—the Giant, the Castle, and the Grand—are calculated to reach the height of 200 feet; one, the Bee-hive, of 219; and one, the Giantess, of 250.

By way of comparison an account is given of the geysers of Iceland and of New Zealand. The height reached by the Great

geyser of Iceland seems to vary much on different occasions. The highest actual measurement given is 212 feet, but as seen by Olafsen and Povelson it was estimated at 360 feet; and Mr. R. Allen says that well-informed natives do not consider it at all improbable that such a height might be reached. Strokhr, which is only about 120 yards from the Great Geyser, does not reach so great elevations, the highest measurement being only 132 feet. The Roarer, once equal to the Great Geyser, diminished since the earthquake of 1789, and has ceased to spout.

It is remarked that the springs in the Yellowstone Park generally present shades of blue, shading sometimes into green. The same colours are found in Iceland, Java, New Zealand,—in fact in every region of hot springs. Many lakes and rivers also, in Switzerland, California, and Norway, have a more or less decided blue shade. Pure water is, in fact, distinctly blue if seen in a sufficient depth, though in ordinary streams and pools this colour is annulled by the brown shade due to decomposing organic matter.

The volume is profusely illustrated, and the views convey striking instances of the gorgeous, yet at the same time weird, character of the scenery.

Canal and Culvert Tables, with Explanatory Text and Examples. Revised Edition, with Additional Tables. By Lewis D'A. Jackson, C.E. London: W. H. Allen and Co.

The current of events is directing public attention much more strongly to canals than has been the case for the last half-century. We are beginning, now the gloss of novelty is worn off, to perceive that railways—however necessary for the rapid conveyance of passengers, of the mail-bags, and of perishable goods—cannot, as far as ordinary heavy merchandise is concerned, compete in price with canals. Men of business are, therefore, awaking to the truth that our recent neglect of the facilities for inland navigation has been a mistake. It is seen that by the application of steam to boats, on properly constructed canals, an average rate of speed can be reached fully equal to that of a goods' train, with the advantages of easier rates, and of delivery and collection at almost any point in the country traversed.

Hence we think that Mr. Jackson does himself and his subject less than justice when he says, in his Preface, that "the portions applicable to culverts perhaps alone being likely to come into frequent use in England."

The author refers to two recent series of observations in hydraulics,—the one a series of velocity observations made for the Government of India on the Ganges Canal. These observations "clearly disprove the accuracy of the old hydraulic formulæ for flow under gravity, and corroborate the positions laid down by the author in his first edition. The other set of observations referred to were conducted by Mr. Baldwin Latham on the tidal portions of the Thames, at the instance of the Corporation of London. The results of these observations, however, have not yet been made public.

Mr. Jackson finds it necessary to point out expressly that his tables for canals and culverts are not intended to apply to rivers of any sort, more especially the tidal.

The second edition before us has been carefully revised, and certain errors, both of calculation and of topography, have been eliminated. Additional tables have been added to the extent of forty pages.

That the work will prove directly beneficial to the engineering profession, and indirectly to all interested in drainage and the supply of water, as well as in internal navigation, is self-evident.

Hay-Fever; its Etiology and Treatment. A Lecture delivered at the London Hospital Medical College. (Reprinted from the "British Medical Journal." By Morell Mackenzie, M.D. London: J. and A. Churchill.

Hay-fever is a fashionable disease of the day, and, although we never came across any person affected by it, it would be idle, as do some, to doubt its existence. Dr. Mackenzie considers that the disease has of late years increased in frequency, and thinks it probable that irritating properties have been newly acquired by certain vegetable bodies. Such a change is by no means out of the question. But it cannot be overlooked that the disease is most common in two countries differing widely in climate and in flora, but both inhabited by a race given to over-work and mental tension under pressure. The two countries are, of course, England and the United States. The late Dr. G. M. Beard ranked hay-fever among the neuroses, though the pollen of grasses, &c., may be one of the principal exciting causes,—perhaps *the* principal. Dr. Mackenzie admits that out of millions of people, exposed alike to inhale the pollen of flowers, very few suffer. The liability appears suddenly, but when once acquired it is seldom lost, and the predisposition seems to increase with each succeeding season. The author states that it is rare on the Continent of Europe. In Asia and Africa it attacks only the English.

In America it occurs in every State, but diminishes in frequency towards the south. In Britain the contrary rule seems to prevail, since it is most common in the south of England and very rare in the north of Scotland. In New York, where the disease is relatively common, it is unknown among persons of German or of French descent, as well as among Indians and Negroes. A singular feature is that this complaint seems most prevalent among "persons of some education and of fair social position."

Dr. Mackenzie decidedly recognises pollen, especially that of the grasses, as the general exciting cause. He adds:—"It need scarcely be said that zealous 'bacteriomaniacs' have, of course, sought for parasitic germs in the nasal secretions of those subject to hay-fever; but although bodies resembling pollen-corpuscles have been found, no specific organisms have, so far as I am aware, been detected. It is almost a comfort in these days to find one disease for which the ubiquitous bacillus does not appear to be responsible."

Into the proposed methods for the treatment of the disease we can the less enter as they are none of them considered satisfactory.

Our Corner. Vol. IV., No. 3. September, 1884.

THIS issue contains but little matter of which we can legitimately take cognizance. There is an interesting account of a fishing expedition in the Western Islands, by Mr. Charles Bradlaugh, M.P. He appears to have appreciated, and to have been in turn appreciated by, the midges, of which there were millions at Loch Long. These malevolent little insects seem to prefer strangers to natives. At least so we should infer from the passage—"In the Western Highlands of Scotland men and women who come from the south are distinguished from the natives by midge marks." We should advise all persons exposed to the attacks of these wretches to anoint themselves with tincture of marsh-rosemary.

"Witches and Witchcraft," by Hypatia Bradlaugh, is a study of a very delicate subject,—much more difficult to deal with than was the case half a century ago. It is manifest that had Mr. Eglinton lived in the times of sapient King James I., or of Cromwell, he would have suffered as a sorcerer.

"The House Fly" is one of a clever series of papers on our "Household Pests," by Mr. J. Horner. It seems to us, however, that he exaggerates the scavenging services of the Diptera. Certain beetles, such as the Geotrupidæ and the Necrophaga, are true or genuine scavengers, since they prey upon carrion and

ordure alone. The flies, on the other hand, settle first upon putrescent matter, and then upon our food or our persons, carrying with them the germs of decomposition and disease. It is all but absolutely demonstrated that they are the chief agents in the propagation of pestilence. The fluids of their bodies, elaborated from decomposing animal matter, are entirely malignant, and being introduced into the bodies of the men and other animals bitten, set up a series of effects which range from the irritation springing from the puncture of a gnat or a midge to deadly carbuncle.

Mr. Horner writes :—" Man, in his cruel ingenuity, has enticed the insect tribes into his service in order to inflict torture upon his fellows." It may perhaps be news to some of our readers to learn that in Eastern Europe, in the olden time, a serf who had offended his lord was sometimes stripped naked and left bound to a tree in some swampy forest, where the mosquitoes tormented him to death.

The " Story of Giordano Bruno " comes to its conclusion, infinitely sad, but not the less glorious.

Longman's Magazine. No. 22, August, 1884. London : Longmans and Co.

The only paper in this issue which can at all come under our cognizance is one by Mr. R. Proctor, on " Earthquakes in England." The author gives a notice of the earthquakes, historical or traditional, which have from time to time shaken this island. Most of these have been of an exceedingly mild character, though we have no direct guarantee that we may never experience a more violent shock. Mr. Proctor's theory is that " every earthquake indicates the continuance of the process of contraction which every orb in space undergoes till it has reached its final condition."

No. 23. September, 1884.

" The Chase of the Wild Red Deer " may suggest a variety of reflections even to those who, like ourselves, feel an exceedingly slight interest in " sport " of any kind, It is surely strange that a people so reckless of animal suffering in pursuit of amusement should be intolerant of a—generally—smaller amount of pain in putsuit of physiological knowledge. We must, however, frankly own that the chase of the wild red deer is a much more creditable affair than the pursuit of a fat, timid, half-domestic animal,

brought in a cart to be hunted by the buckhounds of a certain illustrious lady.

The Index. Vol. V. New Series, No. 6.

This paper, whose praise is *not* "in all the churches," has been forwarded to us with especial reference to an essay entitled the "Religious Confession of an Evolutionist," by Charles Froebel. This memoir is not exactly what we should have anticipated from the title. The writer discusses, calmly and thoughtfully, the "true relation of religion to science, metaphysics, and æsthetics in human nature." He recognises four fundamental phases of psychical life:—"Religion, the infinite synthetical phase; Metaphysics, the infinite analytical phase; Æsthetics, the finite synthetical phase; and Science, the finite analytical phase." Each of these phases, we learn, may evidently appear either in a receptive or expressive mood.

In a following section the author examines the "duties of Religion and Science." We transcribe the following passage as illustrative of the author's point of view:—"For just so long as she (Religion) endeavours indiscriminately to maintain possessions to which she has no title, as well as those to which she has, her efforts will be so enfeebled by the extent of the psychical territories she seeks to control that she will find herself despoiled of everything, till she is poor indeed,—in fact, no religion at all, but the mere dethroned claimant of a metaphysically-garrisoned dependency of Science. To avoid this disaster, Religion must acknowledge her limitations. She must admit that while she claims as her legitimate inheritance that region which Science terms the 'unknowable,' yet the forms dwelling in this region are for her no more knowable than for Science. She must acknowledge that on this field not Science only, but she as well is agnostic,—unable to know. For it is in the form of *belief*, and not in that *knowledge*, that she must and can maintain her rights. To the charge of Science 'You do not know!' she must reply 'My cognition springs from sources of higher authority: I believe!' When Science insists that she has no tangible reasons for her belief, she must answer that she has more tangible wants, affections, and desires. And when she occupies that position Religion will no longer be vulnerable. Like the wonderful shadowy form of some Oriental tale, the arrows of Science will pass through her leaving no wound; the sword of Reason may seem to cleave her, but she will stand there still unharmed,—the eternal, the mysterious, the all-beautiful!"

Science, on the other hand, "must demonstrate to the church-

man not only to what *external* laws of the great analytical power of thought he must *conform* his creed, but also what *internal* laws of the equally great synthetic power of feeling must *inform* his system of beliefs, if he would desire it further to dominate mankind."

A third section is devoted to the "Relation of the Evolutionist to Ultimate Religious Parties." The author quotes here the lines—

> "Diess ist der Jugend edelster Beruf!
> Die Welt, sie war nicht, eh' ich sie erschuf."

Who, by the way, can fail to find here the very essence of "Hylo-Idealism"? The author writes further:—"Regarding the thesis of Evolution as the very soul and essence of modern scientific thought, it is plain that the mind which projects it has a Pantheistic bent, and that either the lens of this thesis must be broken or that only those religious forms which are synrhythmic with its ideas can live within the intense heat and light of its focus. Of all the forms now prevailing in Europe and America but four—Atheism, Spiritualism, Buddhism, and Unitarian Pantheism—deserve our consideration."

Concerning Spiritualism Mr. Froebel writes:—"Probably no other phase of modern religious development is more deserving of philosophic analysis and interpretation."

A paper on "Work and Rest," by W. J. Potter, contains much which we cannot recognise. He holds out small hopes for the future. He scarcely sees that "work" is not merely exertion dictated by necessity or by greed, and leading to material rewards. He writes:—"Work will doubtless become more equalised among different classes of society as the world progresses, and some species of drudgery it may be hoped may be abolished by improved facilities and methods. . . . The leisure that is wanted is only leisure from excess of hard physical toil!" Alas for "progress," if this is all! "Some of the newspapers have recently reported the sad fate to which a number of wealthy young men of good families in New York have, in recent years, been brought through the misfortune of having nothing to do." Very probable; because education and public opinion had trained these young men in the belief that money-making in one form or other is the only occupation, the only work, all other pursuits being alike idleness. But wealthy young men who rise above this vulgar error become the Darwins, the Lyells, the Goethes, the Buffons. If we want progress we must have increased leisure,—leisure not merely from hard physical toil, but from mental toil in the service of greed. And to this end we must go in for plainer living, which alone can make higher thinking possible.

The "Cost of my Orange," by Mr. W. D. Gunning, is an instructive study in Evolution. We can quote merely the

concluding passage:—"If the religion makers of the race had been tillers of the soil and growers of fruit, all religions would have been what Buddhism is—Pessimistic."

The "electric girls" of the Southern States do not meet with credence. "It has been sufficiently shown that when the Georgia wonder—Lulu Hurst—encounters a trained athlete who is stronger than herself and equally quick, neither odic force nor the spirit of her grandmother has the slightest effect upon him."

"The Index" evidently contains much that deserves careful reading.

On the Observations of Earth-shakes or Tremors in order to Foretell the Issue of Sudden Outbursts of Fire-damp. By M. Walton Brown. Newcastle-upon-Tyne: Andrew Reid.

In this pamphlet, which is a reprint from the "Proceedings of the North of England Institute of Mining and Mechanical Engineers," we find arguments in favour of the very probable theory that sudden outbursts of gases may be occasioned by slight tremors of the earth's crust. That such motions occur, and that with considerable frequency, does not require any demonstration; and that the gas liberated in coal-beds will be for the most part fire-damp may also be at once admitted.

The theory, it appears, was first broached by Mr. W. L. Wharton as far back as 1845, by occasion of a curious escape of gas which he observed taking place from the bed of the river Wear. He writes:—"A line of streams of gas was observed crossing the Wear diagonally in the direction N.N.E. and S.S.W. under the Framwellgate Bridge and for a length of about 100 yards. When the air and water were perfectly calm large bubbles formed by the ascent of gas, and taking fire at a lighted candle, marked the limits of the streams of gas above the bridge, and two other smaller groups of bubbles were seen below the bridge. It is believed that there are no coal-workings or excavations of any kind within several hundred yards of Framwellgate Bridge, and the escape of gas must be attributed to some extensive natural accumulation." For its sudden liberation, as described, scarcely any theory is conceivable except the formation of a chink or fissure in the bed of the river by some subterranean movement or vibration. It is hence exceedingly probable that in the coal-fields outbursts of gas may occur along lines of faults.

Transactions of the New York Academy of Sciences. Vol. II. Nos. 1 to 13.

On October 9, 1882, a discussion took place on Mr. F. C. Whitehouse's paper maintaining the artificial character of Fingal's Cave. Considerable difference of opinion occurred, Prof. E. H. Day opposing the hypothesis of Mr. Whitehouse, and the President pointing out the absence of detritus on the shore, and noting the fact that the approaches to the Staffa Caves are over low flat ground, furrowed by canals leading up to their entrances, as if artificially excavated.

On November 20 the Rev. H. C. Hovey delivered a very interesting lecture on "Subterranean Scenery." The lecturer classified caves as volcanic, such as those of Cumana and Iceland; marine, of which the Grotto Azuro, of Capri, and the caverns of Staffa are examples, and inland caves in non-volcanic districts, especially in limestone rocks. A particular description was given of the Luray Cave in Virginia. Such caves,—and the same rule applies to those of Castleton, Adelsbach, &c.—though sometimes ascribed to earthquakes, are really due to the chemical and mechanical action of water. "Acidulated water cuts into the limestone, searching out the lines of weakness, until channels are made leading down to some subterranean outlet. The agency of running streams carries on the work begun by water charged with carbonic acid. Sand and gravel borne in with these streams make of them powerful cutting-engines."

On November 27 Dr. J. S. Phene in a paper on the Mound-Builders argued that they were contemporaneous with the ancient horse and with certain members of the elephant family. As to the camel the evidence is not conclusive.

In a discussion on the physical conditions under which coal is formed Dr. Newberry stated that in passing through the coal-measures from below upwards differences in the flora were traced, but the types were largely interlocked by insensible changes. The *Sigillaria* is abundant below, and as we pass upwards it decreases and disappears.

On January 22, 1883, Prof. Thwing read a paper on the "Treatment of Sea-sickness by the Trance State," induced, it would seem, by mesmerism. The author's experiments confirm the theory of the late Dr. G. M. Beard that the concentration of attention in one direction induces an insensibility to other things, more or less complete.

At the meeting on February 5, 1883, occurred an incident which seems strange to Englishmen of the present day. A resolution, namely, was passed that "The New York Academy of Sciences endorse a petition for Congress to remove all duties on specimens of minerals and fossils, whether imported by dealers,

or by institutions of learning, or by private collectors, so long as they are intended for cabinet specimens and not for use in the arts." Alas that such a petition should be necessary!

Mr. Romyn Hitchcock read a paper on the alleged reticulate structure of bioplasm (protoplasm or bioplasm), which he controverted. In the discussion which followed, Mr. A. H. Elliott referred to the experiments of Mr. Crookes on radiant matter, and enquired whether there were any means of explanation of the motions of the granules of living matter analogous to the molecular motion observed by that investigator. Dr. Schœney remarked that mere molecular motions were simply helped or retarded by the different physical forces, but that the agencies concerned in the phenomena of life were quite different from the other cosmic forces. Mr. Hitchcock observed that it had been suggested, in regard to the distinction between living and non-living matter, that they may differ in the same way as in inorganic bodies—atoms of the same substance are subject to different arrangements—one mode of arrangement being peculiar to living matter.

In a discussion on the determination of organic matter in potable water it was remarked that the water of the Dismal Swamp was dark in colour and teeming with organic matter and yet was not unhealthful.

On June 4th, Dr. J. S. Newberry read a paper among other things disproving the theory—adopted by some English savants—that an ice-epoch must have been a warmer period than at present, with more copious precipitation.

Papers and Proceedings of the Royal Society of Tasmania for 1882. Hobart: "Mercury" Office.

In the "Proceedings" we find the usual climatological notes. The winter seems to have been severe for the latitude. During July (16th) snow fell at Hobart to the depth of 2 to 3 inches. On August 26th another snowstorm occurred, and on July 29th the minimum temperature registered was 21° F.! Even in October, when the horse-chestnuts were in flower and the vines budding, we find mention of flakes of snow.

The principal paper inserted is entitled "General and Critical Observations on the Fishes of Tasmania," by R. M. Johnston, F.L.S. The author enumerates 190 species of fish as occurring in Tasmania.

It is remarked that since the use of seine-nets in the Derwent

above Hobart has been prohibited all fish have rapidly increased in number, size, and quality. It is affirmed that more fish are now caught with rod and line than were formerly obtained by netting.

The introduction of the salmon and the trout into the Tasmanian rivers has proved successful. The acclimatisation of the European herring in the Antarctic Seas is now contemplated.

Mr. R. Etheridge, F.G.S., communicates a description of Trilobites from the Lower Silurian of the Mersey district in Tasmania.

Mr. James Barnard discusses the economic value of *Typha latifolia*. This aquatic plant is used in Italy as a stuffing for buoyant mattresses, cushions, &c. Such mattresses are used on board the Italian navy as a life-saving appliance, one of them being easily capable of supporting two persons in the water. Signor C. A. de Goyzueta, Italian Consul at Melbourne, called the attention of the local Australian Governments to the valuable properties of this plant, and its acclimatisation is in progress. Meantime attention has been drawn to a kindred species, *Typha angustifolia*, indigenous in the marshes of Tasmania, and possessing the same physical properties. The writer justly remarks that cushions stuffed with this plant would often prove the means of saving valuable lives in the capsizing and foundering of river-craft, coasters, &c.

Lieut. C. E. Beddome furnishes a description of some new marine shells of Tasmania.

R. M. Johnston, F.L.S., gives a note on *Olinus despicallatus* and *Boviethys variegatus*, two viviparous fishes.

Messrs. E. T. Higgins, M.R.C.S., and W. F. Petterd, C.M.Z.S., communicate accounts of hitherto undescribed Antechini and Muridæ inhabiting Tasmania.

We regret to learn from the appended Report that both the Botanical Gardens and the Museum are crippled from want of funds.

Papers and Proceedings of the Royal Society of Tasmania for 1883. Hobart: "Mercury" Office.

Among the principal papers here inserted is one by E. T. Higgins and W. F. Petterd, on a new Cave-Spider (*Theridion troglodytes*). This species, the female of which measures $6\frac{1}{2}$ inches from the claw of the anterior to the claw of the pos.

terior leg, is found in a cave in the Chudleigh district. The nest is of the size of a large pigeon's egg. Curiously enough there have been, so far, no insects discovered in the cave on which these spiders could subsist. Several species of mammalian remains have been found agglutinated to the rock by stalactitic incrustations. No carnivorous marsupials have been found. The stalactites of the cave are said to be magnificent.

Mr. F. Abbott, Superintendent of the Royal Society's Gardens, communicates notes on new plants introduced during the season. Prominent among these is the Georgia pitch pine.

A number of rhododendrons and azaleas have been introduced from India, Java, Japan, &c., and will doubtless spread on the sandy and peaty soils of the island.

Dira grandiflora, a splendid terrestrial orchid, native only on the summit of the Table Mountain, has, after many trials, been successfully introduced.

The introduction of new fruit trees has been practically brought to an end for want of room and funds. The writer justly remarks that the task of maintaining and extending such a collection belongs rather to a Horticultural Society than to the Royal Society.

The Museum of the Society continues to receive donations of a very promiscuous nature. We hope that the funds of the Society may suffice for the reception and classification of the specimens, which otherwise will be of little good to Science.

A Mr. Dyer calls attention to a large harmless lizard (*Cyclodus nigrolutens*), which in Tasmania has unfortunately received the name of the "death-adder," and is hunted down in consequence. So far from being injurious to man, it attacks and destroys poisonous serpents in their youth, and therefore justly deserves protection instead of persecution.

We find mention of the after-glow in the western skies, for an hour or two after sunset, as having been observed in the latter part of October.

Two specimens of *Sphinx Convolvuli*, captured in the island, were presented to the Museum by Mrs. Lodder. This species is probably becoming cosmopolitan. We have received specimens of it from the Transvaal and Zulu-land.

Bulletin of the California Academy of Sciences. No. I. February, 1884.

THIS number contains a description of a new species of *Squalius*, by Rosa Smith; a description of a number of new plants, some of which, we regret to find, have been fitted out with a Latin "diagnosis." What apology can be urged for this "survival" we must own ourselves unable to see. New chemical compounds, new physical facts, are not in our days described in a dead language which has the disadvantage of not affording an accurate nomenclature for colours. Why, then, should this antiquated custom be retained for new botanical or entomological species?

The Microscopic Section comprises an enumeration of the Fungi of the Pacific Coast and of California.

The Proceedings of the Astronomical Section contain nothing of marked interest.

CORRESPONDENCE.

*** The Editor does not hold himself responsible for statements of facts or opinions expressed in Correspondence, or in Articles bearing the signature of their respective authors.

HYLOZOISM AND HYLO-IDEALISM.

Absence abroad has prevented my seeing Mr. Billing's late lucubrations on this subject, which are really quite beside the question, in the "Journal of Science," until now. Might I ask, if not too late, that you will kindly allow me space in the October number of your fearless Journal to state, necessarily in the shortest terms, what the *Brain Theory of Mind and Matter* really is, Mr. Billing having already very successfully shown what it is not? C. N., who is a young Collegian, will probably answer more elaborately his mystifications on her return, in October, from Germany.

The aim of Hylo-Idealism, or Auto-Centricism, for it has a hundred other names, is, in the most summary and conclusive way, to abolish the biblical, theological, supernatural, animistic or dualistic system of the World,—*i.e.*, of Life and Mind,—by substituting the scientific, medical, monistic, hyloic, or hylo-phenomenal theory of "things" for that out-worn hypothesis. And it does this by proving, on *data* so very clear now-a-days, that "all who run may read," if they care to do so, that all "things" or "nothings" to which we have access, whether abstract or concrete, can have only a phenomenal or cerebral origin as conceptions or perceptions,—*i.e.*, as objects of sense or thought, which surely are only faculties or functions of the Brain. Man *must* therefore anthropomorphise and *auto*morphise from the very nature of his being,—a truth which unifies subject and object, Ego and Non-Ego, Self and Not-Self, making thus the whole universe intercranial as the creature of sight (sense) and thought. Light itself is not light till manufactured in the posterior chambers of the eye, "which is the only colour box." All Divine Worship or Religion *must* be thus Self-worship, as out of Self Self can never escape, what is outside that sphere being nothing to us according to the immemorial proverbs:—*Quod supra, vel extra nos, nihil ad nos*, and *De non apparentibus et non existentibus eadem est ratio.* Science, and especially

Philosophical Medicine, has in all ages, with more or less certainty, always postulated this hylo-phenomenalism, which in our days is placed quite beyond dispute by the materialistic principles of Bichat's and Hunter's histology, accepted as the only basis of all contemporary sound Physiology, Pathology, and Therapeutics. To Medicine, and not to Mathematics, Metaphysics, or Theology, really belong the "great problems" of Life, Disease, and Death. On these data Hygiene, or supreme culture of body and mind, which latter is only a bodily function, becomes the substitute for Religion or Divine Worship, thus eliminated from reality not merely as a baseless, useless, and mischievous chimæra, but as an *absolute impossibility*. Sir W. Gull posits these same conclusions in his Harveian Oration (1870) as the "categoric imperative" of Modern Medicine, which rigidly excludes all dualistic Animism from nineteenth century Philosophy. Hyloism or Materialism is thus enthroned as the Magna Charta and Monarchos of human Reason. The whole question is really so very simple that it seems to be only complicated by formal argument. On the hylo-phenomenal theory surely every one, learned or unlearned, ought to see that Self *must* be the sole author of its own world, both of sense and thought. All concrete objects, as we see or know them, can be only mental imagery, Deity not excepted. Solipsismal Egoism must be therefore to us the be-all and end-all of existence. Beyond that extreme limit of mortal vision we can never penetrate. Christ termed himself "*Son of God*," but Modern Science, *and especially Medicine*, caps his idea by divinising Humanity itself, by constituting Man, and every separate unit of mankind, *father* of God and of all things visible and invisible to human *Gnosis*.

ROBERT LEWINS, M.D.

September 18, 1884.

WASPS INDISCRIMINATE IN ANGER.

If your correspondent "J. C." should ever happen to pass a wasp's nest which has been recently disturbed, he will receive a very practical answer to his query in your last number.

EXPERIENTIA.

ANIMAL INTELLIGENCE.

Perceiving that the "Journal of Science" pays especial attention to the intelligence of the lower animals, I place at your disposal notice of a fact which I dare say some of your readers will be able to corroborate:—If a workman is allowed to bring his dog with him to any manufactory where he is employed, it is astonishing how quickly the animal finds out "who is who" in the concern. His profound respect for the head of the establishment, and for managers, foremen, and officer-bearers in general, forms an amusing contrast to his sauciness to private workmen.

J. C., of S.

INTERNATIONAL WEIGHTS AND MEASURES.

Certain neighbouring nations conceive that they have just cause of complaint against Britain on account of her tardiness in adopting the metric system; but these grumblers, perhaps, forget that they, too, sin against international convenience. What, for instance, can be a greater nuisance to a non-German than the receipt of a letter or other document written in the German characters? He may be able to speak the language with fluency, correctness, and even elegance, yet, unless he has constant practice in deciphering German manuscripts, he is put to a serious loss of time, and may even be in doubt concerning some important word. Yet Germany shows no signs of a disposition to make this needed reform.

Were we to abandon our old system in favour of the metric standards, we should have to encounter a very tangible sacrifice. All our existing weights and measures, whether of length or capacity, would become so much waste material, involving a loss of probably not less than two millions sterling. In addition, many valuable works, tables, &c., on land-surveying, civil and mechanical engineering, &c., would be reduced to the rank of waste paper. Of the derangement in retail trade, which would fall heavily upon the poorer classes, I cannot here speak. Now what, on the other hand, would it cost Germany to adopt the written characters used by the rest of the civilised world? Practically nothing, except to the spectacle-makers, who would find short-sightedness diminish.

The French, on their part, have a mal-practice which they might very well immolate on the shrine of internationalism. I

mean their habit of distorting foreign names of places, sometimes even of persons, thus rendering their identification often a matter of doubt to a non-Frenchman. In a similar manner they murder scientific and technical terms of Greek or Latin origin. Surely it would be no great hardship for the French were they, in future, for intelligibility's sake, to leave foreign and classical names as they find them.

An Old Technologist.

THE MERIT OF MESSRS. THOMAS AND GILCHRIST *VERSUS* THE ARISTOCRACY.

A contemporary of yours, whom I leave you to guess or to search out, winds up a slashing article with the dictum that "these young men have done more for England's greatness than all her aristocracy, kings and queens into the bargain." Now I should be very loth to depreciate the merit of Messrs. Thomas and Gilchrist, though, as their process is being worked in foreign countries more extensively than at home, it will leave our iron trade pretty much as it found it, if not in a relatively worse position. This, however, is no fault of the inventors.

But the writer to whom I refer seriously under-rates the intellectual achievements of the aristocracy. Robert Boyle and Henry Cavendish were members of the aristocracy. The Marquis of Worcester, the Viscount St. Albans (incorrectly termed Lord Bacon), and the Earl Dundonald were all peers. So in our own day are Lords Rayleigh and Walsingham. Sir Charles Lyell, though not a peer, belonged to the baronetage.

These instances, to which more might be added, prove that the aristocracy have done things for England's greatness fully equal, to say the least, with the invention of the Thomas and Gilchrist process.

Justitia.

POLYGAMY IN CONNECTION WITH THE SUPERIOR SIZE OF MALE ANIMALS.

Great superiority of size and strength in any male animal, as compared with the female of the same species, seems to be so closely connected with polygamous habits, that the one fact may

be inferred from the other. But it is not sufficiently clear which is cause and which is effect. Is the physical superiority of the male an indirect result of polygamy, the perpetuation of the species being left to those individuals which prove victorious in the struggle for the possession of the females? Or is polygamy a consequence of the physical superiority of the males due to some other cause? If the former, we ask why the rivalry between the males, which is more or less common to all mammalian species, has not in all cases produced a marked excess of size and strength, and ultimately led to polygamy? If the latter, we have still to ask why the physical superiority of the male should in some species be so much more marked than in others?

AN EX-DARWINIAN.

[Polygamy seems to depend upon gregarious habits, and upon an ample and constant supply of food. Hence it is practically confined to phytophagous and omnivorous animals.—ED. J. S.]

NOTES.

The following startling paragraph is taken from "Invention and Inventor's Mart":—"A contributor to a local contemporary hears of a house, not a hundred miles from the broad, open thoroughfare of High Holborn, in which there are no less than forty persons living, and in which there is no water laid on to flush the drains. This is a practical antithesis certainly to the Health Exhibition, at which scientific sanitarians are daily theorising."

"La Lumière Electrique" is represented by a technical contemporary as speaking of the "decomposition" of hydrogen in presence of a large number of bodies.

The water wagtails have an intense dislike for larks. The yellow wagtail, or "dish-washer" as he is called in some localities, never fails to chase away any sky lark which he happens to espy.

The late Prof. Dumas said—"If the causes of our marasmus appear complex and manifold they are still reducible to one principle,—administrative centralisation,—which, applied to the University, has enervated superior instruction."

Several chestnut trees on the Boulevard St. Germain, at Paris, which had lost all their leaves from the intense heat and drought, began to put forth fresh leaves and flowers about August 15th. The flower- and leaf-buds have not the same structure as those formed in early spring, which have to protect the future shoot against probable frosts.

"Ciel et Terre" has received a copy of the "Historical and Geographical Almanac of Artois" for 1784. It contains a notice of the pleading of M. de Robespierre—*the* Robespierre—before the Council of Artois in support of the appeal of his client, the Lord de Vissery de Bois-Valé, against a decree of the sheriffs of St. Omer, who had ordered him to remove a lightning-conductor which he had fixed to his house!

According to MM. Werner and Nœlting (Ind. Soc. Mulhouse) the poisonous properties of commercial benzol depend upon the presence of a small quantity of ethyl iso-cyanide.

"Ciel et Terre" records an extraordinary fall of hail on July 13th, at Lombartzyde, near Nieuport. Stones were collected weighing 1 kilo. each. The roofs of the houses were completely shattered.

E. Vial ("Les Mondes"), discussing the physiological part of iron in the animal organism, contends that the active principle in the arterial globules is potassium ferrate, which in contact with reducing agents is broken up into oxygen, hydrated ferric oxide, and anhydrous potassa. The latter compound, after saturating itself with carbon dioxide, conveys this body into the lungs.

The poisonous character of urea, when introduced into the tissues of animals, has been demonstrated experimentally by MM. Gréhaut and Quinquand. In rabbits the fatal dose is 661 m.grms. per 100 grms. of blood.

A letter by one Buissart, a Member of the Academies of Arras and Dijon, bearing date August 2nd, 1783, is abstracted in "Ciel et Terre." The writer speaks of the fogs which prevailed incessantly in June and July, 1783:—"The mixture of terrestrial exhalations, which give a variable and unusual colour to the disc of the sun, fills the public here with dread; everyone makes predictions, and a panic terror seizes even persons of education."

[Mr. Ruskin and the author of the "Vapour Year" would do well to study old meteorological records.]

M. A. Certes ("Comptes Rendus") has examined the effects of high pressures upon the bacterium of "charbon." He exposed infected blood for twenty-four hours to a pressure of 600 atmospheres. The blood retained its virulence, and cultivation experiments made with it succeeded perfectly. It seems to the author that in most cases there is a want of identity between the chemical processes, and even the microscopic agents of putrefaction, according as it takes place in the open air or under pressure.

Sir James Paget states that we lose in England and Wales every year, in consequence of sickness, "as much work as twenty millions of healthy people could do in a week." But considering the over-crowding of every trade, business, and profession, and the numbers of people unable to meet with employment, we may venture to ask could a week's work for twenty million people be found?

Complaints of over-work in German schools are abundant, and several decrees have already been issued, restricting the quantity of home-study required and limiting the classical studies.

Dr. Gressin and M. Bottard, of Havre, have discovered the poison-glands and emissive ducts of the fishes *Trachinus draco* and *T. vipera*. The venom, extracted and injected by means of a Pravez syringe into frogs, fishes, birds, and small mammals, quickly brought on clonic convulsions, collapse, and death. The opercular spines serve for the introduction of the poison; the mechanism is exactly the same as in the viper, only the spines, instead of having merely one channel like the fang of a death-snake, have each two.

According to "Ciel et Terre" the vibrations caused by the passing of a railway train, even at distances of 1300 to 1500 metres, make the use of delicate astronomical instruments impossible for the time being.

M. Pierre Picard considers the sun-spots as aërolites which have fallen into the sun, and which preserve on its incandescent surface the spheroidal state during the entire duration of the spot.

M. C. Fievez, of the Royal Observatory of Brussels, contends that the temperature of sun-spots is higher than that of the sun's disc, since the spectral rays of the former are broader than those of the latter.

M. G. Rafin, in a communication to the Academy of Sciences, describes a species of ant which he has observed in the island of St. Thomas, and which he proposes to call *Formica ignivora*. A large fire of wood having been kindled at a certain distance from the ant-hill, he saw the ants precipitate themselves into it by thousands, until it was completely extinguished.

M. W. Vignal ("Comptes Rendus") shows that there is no point in the embryonic development of the spinal marrow of vertebrate animals when it can be compared to a series of ganglia attached end to end, and resembling the nervous chain of the arthropods.

Herr Krasan, in "Engler's Jahrbuch," gives instances of the modification of plants by the action of insects, so as to produce new vatieties.

A certain Dr. O'Donnell proposed to visit the principal American cities, taking with him a couple of Chinese lepers as illustrations of a popular lecture. The authorites have refused their sanction.

We are glad to find that the "Medical Press and Circular" supports the proposal of scientific assessors in Courts of Law.

Extraordinary Freak of Nature; an Egg within an Egg.—Mr. W. T. Wiseman, F.R.G.S., &c., on opening a duck's egg, a few days ago, discovered inside, in addition to a perfect yolk, a small round egg, about the size of a pigeon's egg. The shell was hard, and the colour a beautiful electric blue. We should like Prof. Owen's explanation.

Our friend and contributor, Professor R. Galloway, has ready for the press a work on the Extraction and Manufacture of the Kelp-Products. The book will contain drawings of a kelp factory, with the different vessels all drawn to scale. The processes given for the manufacture of iodide and bromide of potassium, and the re-subliming of iodine, will enable the manufacturer to produce these important articles at a remunerative figure.

A writer in "Notes and Queries" says that, at a recent meeting of the Cambrian Archæological Society, Colonel Evans Lloyd exhibited a stone which was said to open at the death of any member of the family to which he belonged!

We are glad to find that a Natural History Club has been founded at Aylesbury.

It appears that an exhibition of noses has been held at Vienna. The first prize was awarded to the possessor of a huge nose of a purple hue!

Dr. J. E. Rombouts ("Archives du Musée Teyler) denies that the power of flies to walk on glass is due either to atmospheric pressure or to the exudation of a viscous liquid, and ascribes it to capillary attraction.

Prof. Young agrees with Dr. Gould that the effects of sun-spot periodicity, if they exist at all, are likely to be very different in different portions of the earth. . . . In some regions it may be warmer and drier during a sun-spot maximum, while in adjoining countries it is the reverse.

Dr. Dolan, in an essay on Rabies, remarks that "experiments properly conducted and properly interpreted will ultimately lead us to the discovery of the remedy." He adds:—"We need not expect that any Englishman will find this out, for we are so under the dominion of a false humanity that experiments on animals are out of the reach of many who might throw light on this disease."

We regret to announce the death of the eminent American microscopist, Dr. J. J. Woodward. The deceased, who may claim perhaps the highest rank in microscopic photography, was only in his fifty-first year.

A Mr. Thomas Bayley proposes, in place of cremation, to place the bodies, loosely wrapped in cotton-wool, on shelves in catacombs exposed to currents of cold air, dried by passing over calcium chloride. The fumes are to be passed through furnaces into the sewers. This scheme is far inferior to cremation, as being evidently much more costly, and as taking up room almost as much as burial.

Dr. Pringle ("Medical Press") declares that were it not for vaccination no European force could hold India.

The "American Naturalist" has an interesting notice of the abnormal diet occasionally indulged in by the domestic cat,—such as raisins, sugar-candy, figs, and preparations of Indian corn.

[We have known instances of cats stealing raisins; and Mr. Bates mentions the domestic cat as feeding on the fruit of a species of palm-tree, in Brazil.]

With reference to the letter of "Alastor," in our last issue, we quote from the "American Naturalist" some observations by Mr. Clarence M. Weed, of the Michigan Agricultural College. He writes:—"In five instances I saw a large species of *Bombus* fly from the flowers of the common lousewort (*Pedicularis Canadense*) to those of the vetch (*Vicia Americana*), and *vice versâ*. In another instance a *Bombus* went from a blue hyacinth to a columbine. Another went from the flowers of a small Solomon's seal (*Polygonatum biflorum*) to a dandelion. Another was working on vetch, from which it flew to the flowers of a trumpet honeysuckle (*Lonicera*), thus visiting in succession flowers belonging to different families."

Said Prof. Esmarch (as reported in the "Medical Press")—"Our students have been compelled to spend the best of their time in acquiring knowledge very desirable for a philologist, but for a future physician of very little use, and they frequently come to the University with *deadened senses*."

According to the "Medical Press and Circular" some very curious remedies have been proposed for cholera. One man recommends urine to be drank, and another water in which a healthy man has bathed!

The condition of the Paris Museum of Natural History is deplorable. Its entire income falls short of £40,000. Out of this sum have to be paid nineteen professors, fifty-six assistant-professors (*aides-naturalistes*), besides a large number of draughtsmen gardeners, librarians, secretaries, clerks, curators, laboratory servants, &c., in addition to the entire cost of keeping up the Jardin des Plantes, with its conservatories and menageries.

There are no laboratories for the professors of botany, geology, mineralogy, and comparative pathology. There is no botanical gallery, though there is a considerable botanical collection awaiting arrangement. There are no funds for utilising the land bought in the Bois de Vincennes for cultural experiments. There is no marine zoological station attached to the museum; the galleries of palæontology need improvements; an additional assistant is required to classify the anthropoda, and another for the mollusca, &c. The anthropological gallery and library need enlargement. The library contains 100,000 volumes, and was built to receive only 30,000.

According to "Science," the decrease of the forests in the Russian provinces of Moscow and Nishni-Novgorod has been attended by a deterioration of climate and a diminution of fertility. The Moscow Government used to be rich in fruit trees, but apples and cherries have now greatly fallen off in number, whilst pears have wholly disappeared.

Herr Christiani ("Verhandl. Physiol. Gesell. Berlin") has discovered in the brain the centre of co-ordination,—that is, a defined spot, the integrity of which is essential to the co-ordination necessary for locomotion, and for the maintenance of equilibrium during sitting and standing. Its destruction involves immediate and permanent abolition of the normal use of the limbs. It is situate in front of the inspiratory centre of the third ventricle.

ERRATUM.—In our September issue, p. 558, line 13, *for* "with acute mental" *read* "sentimental and."

2.10.84.

TWENTY-FIRST YEAR OF PUBLICATION.

THE

JOURNAL OF SCIENCE,

AND ANNALS OF

ASTRONOMY, BIOLOGY, GEOLOGY, INDUSTRIAL ARTS MANUFACTURES, AND TECHNOLOGY.

(MONTHLY, FORMERLY "THE QUARTERLY JOURNAL OF SCIENCE.")

POST TENEBRAS LUX.

Vol. VI. (Third Series)
No. CXXXI.

NOVEMBER 1884.

CONTENTS.

LONDON:
3, HORSE-SHOE COURT, LUDGATE HILL.
Where Communications for the Editor and Books for Review may be addressed.

PRICE ONE SHILLING AND SIXPENCE.

THE

JOURNAL OF SCIENCE.

NOVEMBER, 1884.

I. THE WAY TO THE POLE, AND SOME OBSERVATIONS OF THE GREELEY EXPEDITION.

By the Count O. Reichenbach.

When, in the January number of the "Journal of Science" for 1884, I showed that by theory I had anticipated what Baron Nordenskjœld found and misinterpreted, and when the observations of the Greeley Expedition again confirm my theories, my view about the way to the Pole deserves examination when new expeditions are projected.

In March, 1869, the following letter was addressed to the "Cologne Gazette," but not published "because it might interfere with the sending of Captain Koldeway's Expedition." A needless fear; for it would have as little altered the mind of its promoters as its communication induced the leaders of the Austrian Expedition to try that route "whose first stage" "is the mouth of the Lena," "which Professor Nordenskjœld hopes to reach this year on his way to Behring Strait."

"To the Editor of the 'Cologne Gazette.'

"You favour the Expedition promoted by Dr. Petermann. He says the stream which runs along the coast of Greenland comes from the Obi and Lena. Being right, he strangely sends his ships against, not with, the ice driving.

"The Pole is the ultimate aim. My view of the true way to reach it is based on a general theory of the configuration of the earth and of oceanic circulation. The ocean

divided by continents resembles lakes connected by streams and currents; their height and temperature change with seasons.

"The Arctic lake joins the others by three inlets. The current of the warm stream which chiefly feeds it comes from Central America, from the longitude of Pailon, through 90° north by east; it crosses the Arctic circle in the meridian tangent to West Africa under the Equator; its mean line of intensity is inclined 23° 28′ to the meridian.

"As the Central American waters are moved 7° 52′ north by Panama, and in a second wave 6° 52′ + 3° 52′ = 10° 44′ by South America, so they are moved through equal latitudes to Spitzbergen Bank and to Spitzbergen, and from the entrance of the White Sea to the north of Novaya Zemlya. The northward movement of the sun towards the end of December is accompanied and followed by an increasing, accelerated, warmer flood of the stream. The water rises in the Arctic lake through over three months, continues somewhat less time at about the same mean level, and then falls and stops through similar periods. The level within the lake itself and its outlets differs, and varies besides regionally.

"The waters leaving the Caribbean Sea at the end of December begin to arrive at the places named about the end of April and beginning of May; having travelled within the circle through an arc of 23° 28′ + 3° 52′, they reach and round Cape Tcheljuskin, projecting 10° 44′ north of the Arctic circle, before the summer solstice, gradually spread to Behring Strait, 46° 56′, the diameter of the polar circle, distant from the Maelstrom, their point of entrance in the circle and join the small current entering at high water through that strait from the Pacific Ocean.

"The great stream, in the mean inclined 23° 28′ to the meridian, tends back south by east after having run through the 90° to the Arctic circle. As its current is, however, moved 3° 52′ farther north by the Finnian North Cape, the stream still further corresponding to Panama and South America north of the Equator, the greatest tendency of return south by east only sets in towards the east of the White Sea. The warm stream, cooling down to the greatest density of sea water, sinks therefore only east of that sea below the colder water and ice of the lake all along East Russia and West Siberia. It first presses from the deep against the ice-bound coasts, then, filling the lake, lifts the ice. Later on, when the flood still rises, the ocean current resisted, turned back by the land, has to move north towards

the Pole; it is assisted by the rising warming rivers. It reappears at the surface of the inundation; the broken ice is driven from the Arctic coasts of the old continents, and lodges and packs in a semicircle from Spitzbergen east and north and north-west, heaving hither and thither on the boundary of the stream flowing in from the south, to the west and north of Europe towards the east, then straight north, and returning on itself back to the south at its own west, along East and West Greenland.

"At the end of June the lake is at high water, also at its east. The ice-driving, which commenced in the current after the solstice, lasts till about the Equinox, then comes to a stand-still with the falling water and increasing cold.

"The current, risen to the surface, starts at the end of June from both sides of the peninsula, flanked by the mouths of Obi and Lena, but principally from its east side from the Gulf of Chatanga. Its course is best shown by describing from the point of entrance into the Arctic circle 6° longitude west of Norway, as centre, with a radius of 23° 28′, an arc starting from the coast of Siberia (Jennissey) through the North Pole and back, and another such arc from the Finnian North Cape, with the same radius, starting from the Gulf of Chatanga, reaching 3° 52′ beyond the Pole. These arcs, starting from both sides of the North East Cape (Tcheljuskin) have the current between them until it divides between the Pole and 87° N. lat., to the north of Greenland, and flows out to both sides of the latter, meeting at its west the outlets of its own side waters and of the small stream entering through Behring Strait. The branch flowing out to the east of Greenland is separated from the side or still waters of the inflowing stream by a submerged ridge discernible by Iceland, Jan Mayen, &c. The whole eastern side of the current and stream from north of the Lena to beyond the Pole will be marked by small islands.

"When the inflowing stream rises rapidly with the spring Equinox it inundates the outflowing branch from south to north: on this depend the oscillations of the pack-ice. The opposite takes place at the opposite season. It is side water of the oceanic motion, south to north, which principally after the spring Equinox appears as counter current south to north, most ostensibly along the west coast of Greenland.

"The Arctic Archipelago and Greenland extend to 23° 28′ + 3° 52; north of Cape Farewell, in 59° 38′ N. lat., to 83° 6′ (small projections balanced by recessions representing inferior disturbances); but Greenland has at its

east, in about 20° W. long. Gr., a peninsular or long island extension reaching 3° 52′ farther north to 86° 58′, at its northern end, with a bend west, turning part of the return current to the east of Greenland. To the west of this mole, protecting Smith Sound, pack-ice periodically settles, and is cleared out again in years of particular high water (nutation).

"If a vessel coming from the West wintered in or to the north of the Gulf of Chatanga, and then followed the great current as soon as the real ice-driving begins its motion north, about the end of June, she might—keeping to the course described—perhaps navigate past the Pole and return along the east of Greenland, or, crossing the still water, arrive at Behring Strait, or get to Smith Sound; and if the vessel had there to be abandoned, the Expedition might possibly get back by land; the undertaking to be confined to the shortest time possible, and to be carried out by a combination of governments and private promoters taking an interest in a scheme whose scientific results hardly compensate the sacrifices incurred.

"The ice-driving will be in full swing round the Siberian peninsula at the end of June, but the larger mass of ice will only float off several weeks later (Von Middendorf found the mean temperature of the Bogonida, a small river of the Siberian peninsula, +10° 6′ (in August). Would it, then, be better to work on at once amidst the ice in June, or to lose the best time and wait till the end of July?

"The vessel keeping to the eastern side of the current, taking advantage of its theoretically presumable bend, ought rather to avoid than seek the bordering islands; for the object of Arctic adventures ought not to be the discovery of a few more patches of land, but the insight into the configuration and oceanic circulation of the Polar regions."

In the January number (1884) of the "Journal" may be found what I said in "On some Properties of the Earth" (1880) about the south and middle parts of Greenland and their interior; but also about the still unknown north-east and the north-west, and Grinnelland, about the Archipelago, and about the open sea of Dr. Kane; it is confirmed by Lieut. Greeley's reports.

And I shall have again to quote from "On some Properties" in speaking of Lieut. Greeley's continuous careful observation, for which he sees, however, no explanation, that the tides, which "at their most northern settlement flowed from the north," averaged 3° F. below freezing-point, equal

to $-1{\cdot}666°$ C., and was $2°$ F. warmer than at Cape Sabine, where the tide flowed from the south, and therefore averaged $5°$ F. below freezing-point, equal to $-2{\cdot}77°$ C.

The figure 1·666, and the temperature 1·666°, and its negative $-1{\cdot}666°$ occur so often in the volume named that I shall only quote passages bearing more immediately on the apparently anomalous phenomena observed.

Pages 10, 11.—" The direction of the Isorachis is determined not only by the size of the oceans and the width of the channels, but also by those streams with whose motion the influences of moon and sun combine." " In the Arctic sea the tide goes north where the stream enters, south where it leaves."

Page 97.—" The average temperature of an upper 1·41′ thick layer of the earth is 20° C.; the vapour leaves it at 20°: that of the equally thick sublayer is—

$$20°+1{\cdot}666°-0{\cdot}43°."$$

Page 98.—" Ocean water has a greater capacity for heat than water; it requires a higher temperature to boil and a lower one to freeze; it changes its nature by evaporation and by freezing; it is diminished by the salts in the first case, and dismisses them in the other: these changes set in at 1·666° and $-1{\cdot}666°$ C.

Page 99.—" The ocean must have *an own temperature* of 1·666° C., and an upper layer of the land will also have an own temperature of 1·666°."

Page 177.—The Earth, as it is, is part of the Solar system. It has in its outside layer, to the depth of 15,180 feet, *an own temperature* of 1·666°, which is the product of its growth, and a temperature which is the product of the continuous action of solar gravity on the gravity of the Earth."

Page 209.—The mean temperature at the bottom of the sea is 1·666° C."

Page 113.—" Ocean water has qualities playing an important part in the distribution of temperature; it does not only yield, it also absorbs vapour, and prevents local excesses of heat, rain, and freezing; it maintains its circulation."

Page 194.—" The vapour absorbed by the sea being $8{\cdot}87' \div 3{\cdot}83 = 8{\cdot}87' - 6{\cdot}56' = 2{\cdot}3'$ of water, the $1 \div 1713$ of the sweet sea (or 78·07 inches out of the 106·49″) return as rain, snow, hail, fog, dew, and hoar frost. The $2{\cdot}31' = 27{\cdot}7''$ absorbed by the sea, beyond 30° of latitude, and principally in the highest latitudes and polar regions, maintain its temperature in the midst of the winter at $-1{\cdot}666°$ in those

regions; the temperature becomes only locally lower when the returned sun begins to melt the ice, principally the drifting land ice."

Page 194.—"All vapour from the Earth gets divided into waves with ascending and descending branches. The greatest mass of vapour ascends from the tropics. As the decrease of temperature" (with height) "is there more rapid, and with it the decrease of maximum tension of vapour, precipitation as rainfall will also be greatest in the meteorological tropics. But a portion of the originally greatest mass of ascending vapour penetrates, by the relays of heat afforded by precipitation, to the heights of the atmosphere; thinner vapour waves, with greater radius and orbit, and increasing velocity of ascent in the rarefied air, overreach the smaller, more dense, and pass with their descending branches on to the highest latitudes to be absorbed by the sea as vapour; they bring cold in the air, which becomes heat in the sea."

Page 115.—In the highest latitudes, in the long nights of the Polar regions, and at times in subpolar climates, there is little or no evaporation, but only absorption of vapour warming the sea. Capt. Nares found in the Arctic regions the lowest temperature of the sea 'during winter' (not at the time of the greatest cold) '$-2{\cdot}08°$ C.,' for only when the warm season begins this temperature sinks below that of the air; this is $-0{\cdot}43°$ in excess of $-1{\cdot}666°$: he also found the water on several occasions at the surface lower in temperature than that of the underlying stratum, absorption having the like effect as evaporation,—not the salt but the water being now most warm and most dense, being below, yet nearer, the $+4{\cdot}1°$, than in the somewhat warmer climates. On one occasion the difference amounted to $0{\cdot}83°$, almost twice $0{\cdot}43°$. If these observations had been regular the average excess in the immediate substratum below about $1{\cdot}14'$ would have been $0{\cdot}43°$."

Page 116.—"Heat leaves the upper stratum in opposite directions; the sea decomposes the $1{\cdot}666°$ between sea and salt, turning $0{\cdot}435°$ into vapour ascending into the atmosphere, and $1{\cdot}231°$ into brine, which sinks by increased specific weight." This is true for the Polar regions with the negative sign; the $-2{\cdot}77°$ of the tide at Cape Sabine were close to $-1{\cdot}666° + (-1{\cdot}231°)$.

Page 127.—"The reason for this high temperature" (the $-1{\cdot}666°$) "is, sea-water of normal saltness below $1{\cdot}666°$, and under pressure of one *air* atmosphere, does not attract, but absorbs, vapour. It is not the water but the salt which attracts the vapour.

Page 128.—" The attractive and repulsive, heating and lighting effects of the Sun and the Earth vary. The $1 \div 29{\cdot}78$ of salts balances the inequality of action, within sea, atmosphere, and land. When the Sun draws nearer and farther, evaporation and the distribution of temperature vary in water and air, and the displacement of weight and water is balanced by weights of salts moved in opposite directions. This will be true *for the tides* solar and lunar: I do not speak of the Moon; it would make complication more complicated. Large masses of water cannot be raised and dropped without the distribution of their temperature and of the salts they contain being affected. The continents heated by the Sun, overspread by the atmosphere, pressed and shaken by the sea, and acted upon by the consequent frictional heat engendered in elastic matter between shell and nucleus, must participate in all oscillations."

Page 127.—" It is not the greatest cold, but the going cold, the ice of the land and the icebergs melting, what makes the sea coldest. The mean temperature of the upper 1·14′ layer of the open sea, or the sea below the ice, is $-1{\cdot}666°$ C."

The wide surface of the Arctic lake through which the stream and current circulate most attracts the descending warming vapour. The stream flows out to both sides of Greenland. At the west, far more still than at the east side, it is confined within straits and channels, encountered, dammed up, and repressed by the greater mass of water moving past from south to north along America towards Europe; it so sinks as current below the inundating waters, increased by the saltless waters from on land, and increased and deprived of heat by the masses of melting ocean and land ice; deprived of power of attraction for the descending vapour, which becomes to a great extent deposited as ice on land, diminishing the proportion of decrease of temperature with height in the overlaying air. The outflowing stream so has its tide from the north, the inflowing inundation water has it from the south.

At the most northern settlement the only outflowing stream, with the tide in the direction of its motion, had at surface the normal Polar ocean temperature $-1{\cdot}666°$, and the height of the tide reached in Franklin Bay 8 feet; at Cape Sabine the temperature of the tide of the spurious stream from the south was $-2{\cdot}77°$, and the height of the tide reached 12 feet: $-1{\cdot}666°$ being to $-2{\cdot}77°$ as 8′ to 12′, the heights of the tides were, singularly enough, as the temperatures below freezing-point, and both as 1 : 1·666,—a curious coincidence.

At some point farther south the temperature would have shown the full $-1{\cdot}666^{\circ}+(-1{\cdot}235^{\circ})= -2{\cdot}897^{\circ}$. And there must be between the two stations of observations a line oscillating with seasons and years, where the two tides from north and south meet, the higher one overlapping, and the former passing with a temperature $-1{\cdot}666^{\circ}$ below the other with a maximum cold of $-2{\cdot}897^{\circ}$.

This will produce north of the line of meeting by the mixing of the waters, by the thinning out of the southern and the thickening of the northern tide, by the more eager absorption of vapours by the more salted northern waters (salt being precipitated from the upper colder layer), by the motions of the different salts (with regard to which I must refer to the volume quoted), by the friction and contact of the two tides, we may say the $-1{\cdot}666^{\circ}+(-0{\cdot}435)=2{\cdot}08^{\circ}$ in the upper layer and the $-1{\cdot}666^{\circ}-(-0{\cdot}435^{\circ})$ in the sublayer, observed once as an extreme case of the rule of temperature between the two layers by Captain Nares (see quotations from page 116 and page 115, as before).

II. FIREBALL RADIANT IN SEXTANS.

By W. F. Denning, F.R.A.S.

THERE is a prominent meteor shower from the N.W. limit of the small constellation Sextans (Hevelius), the place of the astronomical radiant point being at about $\alpha\ 145^{\circ}\ \delta+6^{\circ}$, which is some 8° S.W. of α Leonis and 15° N.N.E. of α Hydræ. The display is a remarkable one for two reasons,—namely, its apparent persistency, and for the immense fireballs which it occasionally yields from about the end of January to the middle of March, and probably later.

On February 13th, 1871, 9 h. 4 m., I observed a large fireball which in point of size and brilliancy rivalled the full moon. It traversed the southern part of Orion, disappearing at $62\frac{1}{2}^{\circ}-15^{\circ}$, where it projected a vivid streak for ten minutes. This meteor was also seen at Rugby, where the recorded path was very similar to that descried at

Bristol; it was likewise noticed at many other places, including Exeter, Torquay, and Callington in Cornwall.* The radiant point from a comparison of the observed flights is north of α Hydræ. Mr. W. H. Wood described it as "near α Hydræ," from his discussion of the observations.

On February 2nd, 1876, 8 h. 31 m., I saw a small bolide, equal to Mars, threading its way slowly along a short arc amid the stars of Coma Berenices. Path from $175°+31°$ to $185°+35°$. On February 4th, of the same year, at 7 h. 35 m., I recorded a slow-moving fireball emitting a light about $\frac{1}{3}=☽$. It traversed a course of 24° between Taurus and Eridanus. This meteor considerably exceeded the small bolide of February 2nd as regards magnitude and visible effect, but otherwise their features nearly coincided, and the relative directions exhibit a radiant near the star α Leonis as their point of mutual intersection.

On March 17th, 1877, 9 h. 54 m. a large fireball, estimated $\frac{1}{2}=☽$, was observed at Bristol as it travelled slowly through Monoceros. The same meteor was seen and described from many other parts of the kingdom. Col. Tupman computed the orbit, and found the apparent radiant at about $145°-4°$.†

On January 27th, 1879, 14 h. 28 m., an immense fireball, with a diameter said to exceed 2° ($4\times☽$), and casting off a perfect ring of fiery sparks, was seen in America. It "produced a violent explosion like an earthquake's shock, in Traverse City, Michigan," and moved slowly from a radiant at about $142°+14°$, according to the combined observations at Wisconsin and Michigan.‡

On February 21st, 1879, 12 h. 20 m., a vivid fireball, with a nucleus half the moon's apparent diameter, was seen in Essex, Suffolk, and Cambridgeshire. It "burst into fragments with a report like thunder, heard in less than half a minute at Haverhill and at Saffron Walden in Essex." The radiant point was at $140°+5°$ ($\pm7°$), near the head of Hydra.§

It is to some extent questionable whether these fireballs were severally evolved from the same parent stream, but the fact is a suggestive one that the relative directions are so closely conformable to one centre, that, allowing for the probable errors of observation affecting the individual instances, a common derivative radiant may justly be attributed them. In any case it may be regarded as proved that here, in the special region included between the stars α Leonis and α Hydræ, there is a well-defined and singularly persistent radiant of fireballs, some of which are detonating and of

* British Association Report on Luminous Meteors, 1871, p. 33.
† Monthly Notices, vol. xxxvii., p. 353; and Observatory, vol. i., pp. 19, 20.
‡ Monthly Notices, vol. xl., p. 257. § *Ibid.*

very great magnitude. The display is obviously of such striking character as to render it eminently suited for future investigation. The brilliant and startling aspect of its more conspicuous meteors, the seeming endurance of the shower far beyond ordinary limits, and its very favourable position in the winter sky, will doubtless cause it to attract many further observations. Showers of shooting stars of the normal type very probably issue from this radiant of fireballs, and it may be assumed, from the conclusive evidence afforded by other such streams, that they are not only concurrent in date, but closely associated in their physical origin. Whether the earlier meteoric displays which occur from the same region during the months of November and December have any distant connection with those operating in February, March, and early in April, is entirely a matter of conjecture in the present state of our knowledge. If we accept the theory of correlation between the successive groups of shower-meteors projected from this point of the sky during the winter months, we have an instance of the visible sustenance of a stream which far exceeds what is regarded as possible, so that pending renewed observations it will be safest to admit the extremely doubtful nature of the case. Though these recurrent showers from Sextans furnish a well-defined and apparently continuous radiant during the winter months, they may really consist of a succession of interwoven meteor groups whose peculiar arrangement has originally been due to the cumulative effects of perturbation exercised by the earth in her annual passages through the primitive stream.*

The series of radiants which have been previously determined are concentrated round the point $145{\cdot}4^\circ + 3{\cdot}9^\circ$ as follows:—

No.	Epoch.	Radiant. α	δ	Observations.
1.	1872, Oct. 29—Nov. 13	147°	+ 2°	†D. (from Ital. Obs.), 6 meteors.
2.	1876, Nov. 25—Dec. 21	148	+ 2	D., No. 46, 1876, 11 meteors.
3.	1877, December 8 ..	145	+ 7	D., No. 153, 1877.
4.	1870, January 4	142	+ 5	Tupman, No. 3.
5.	1880, January 7	140	+ 7	Sawyer, No. 1, 2nd catalogue.
6.	1877, January 9—17 ..	146	+ 4	D., very slightly observed.
7.	1870, January 11 ..	149	+ 5	Tupman, No. 3.
8.	1850-67, Jan. 3—Mar. 16	143	− 7	Greg and Herschel, No. 15.
9.	1872, Feb. 1—Mar. 12	147	+ 4	D. (from Ital. Obs.), 17 meteors.
10.	1878, Feb. 24—26 ..	145	+ 8	Sawyer, No. 3, 1st catalogue.
11.	1872, Mar. 31—Apr. 12	147	+ 1	D. (from Ital Obs.), 7 meteors.
12.	1872, April 3	146	+ 9	Zona (stationary meteor).

Mean position from 12 observations = $145{\cdot}4^\circ + 3{\cdot}9^\circ$.

* See a condensed summary of Sig. Schiaparelli's views on the probable cause of diffuse and multiple radiants, and on the occurrence of families or groups of radiant points, in the British Association Report on Luminous Meteors for 1871, pp. 44 to 48.

† Refers to positions determined by the writer,

I believe the centre of the shower thus derived is very accurate in right ascension, but the declination is too far south. On December 8th, 1877, I witnessed this stream in special activity, and the point of radiation determined on that occasion was regarded as very sharply defined. This taken in conjunction with the pairs of positions by Col. Tupman and Mr. Sawyer (both of whom conducted and reduced their observations with considerable precision) indicate the radiant in $\delta = 6^{\circ}\cdot4$, so that the place assigned from the twelve values is probably $2\cdot^{\circ}5$ south of its true centre, owing in some measure to the very erratic, southerly position of No. 8. Let us compare the average radiant of the three great fireballs of 1877 and 1879 with that resulting from the above summary:—

		α	δ
Fireballs of 1877 and 1879	...	$142^{\circ}\cdot3$	$+5^{\circ}\cdot0$
Meteor showers, 1857—80	...	$145^{\circ}\cdot4$	$+3^{\circ}\cdot9$

The mean places of the radiant are therefore separated by little more than 3°. But the very grave doubts existing as to whether the whole series of showers is connected in sufficient degree to warrant their being thus incorporated and averaged must greatly detract from the significance of the accordance in the resulting positions. There are probably several distinct systems of meteors proceeding from nearly the same foci in Sextans during the months November to April, but their individual durations and epochs of maximum display cannot be attributed owing to the meagre character of the observations on which they are founded. It will be an essential part of future investigation to ascertain whether there is a continuous run of meteors from *exactly the same centre* in this region during the months from November to March. The fact is affirmed by the most reliable observations hitherto obtained, and it is singular that Sig. Zona, at Caltanisetta in Italy, observed a stationary meteor at $146^{\circ}+9^{\circ}$, on April 3rd, 1872, and close to the point $145^{\circ}+8^{\circ}$, where Mr. Sawyer, at Cambridgport, Mass., obtained a similar observation on February 24th, 1878, and where, on December 8th, 1877, I had determined the exact centre of a well-defined meteor shower.

In November and December the meteors discharged from this point are of identical type to the Leonids of November 12th to 14th; they are rather bright, moving very swiftly and uniformly leaving streaks, whereas the conformable meteors seen in the months of February and March are slow-moving, and it would seem of comparatively greater

magnitude. The former difference is the natural outcome of the change in the astronomical conditions affecting the apparent motions of the meteor particles relatively to that of the earth at the two epochs. Thus in November, when the radiant is near the earth's apex, the velocity of the particles at impact is near the maximum (about 44 miles per second), inasmuch as they fully confront the earth, and there is a direct *rencontre* at that time. The orbital motions of the earth (18·5 miles per second) and meteors (26 miles per second) are therefore combined in the observed effects. But early in February the circumstances are very different, the relative directions being nearly at right angles; hence the apparent velocity of the meteors accords with their real or native velocity. Later on this becomes further reduced, until the radiant point being near the earth's anti-apex, and the paths of the meteors and the earth being parallel in the same direction, the apparent meteor speed reaches a minimum of some 11 miles a second. Even during short periods great changes are effected in the conditions under which meteor showers are presented to our observation, and they are of such character as to suggest the utter inconsistency of individual streams having very long durations and fixed radiant points. But the fact of these consecutive showers from the same derivative point in Sextans is so well attested, and the same peculiarity so clearly demonstrated in regard to many other systems, that (though we may admit the difficulties attending its explanation) the subject should not be lost sight of by those who would form a right conception as to the phenomena of meteors. Anomalies of the character referred to may tend to induce further investigation, and lead us to modify our views as to the visible behaviour of certain streams which may show a width and construction of orbit entirely opposed to such well-defined though fugitive displays as the Quadrantids, Lyrids, Andromedes, and Leonids, which constitute groups of very special character, and cannot be regarded as typical of the multitude of more attenuated and apparently long-enduring showers with which the heavens so numerously abound.

It is worthy of note that this well-defined radiant point in Sextans does not appear in the catalogue of Sig. Schiaparelli's reductions of Zezioli's meteors of 1867-70, which contains a very large number of observations for the earlier months of the year. The shower was not quiescent at that time, as we know from Col. Tupman's records, which were of contemporary date. There is also no mention of this position in either of the extensive catalogues of Heis and

Schmidt; but very few paths were accumulated by these observers in January and February, and hence the radiant might easily evade discovery.

The fact that the finest meteors from this stream have been recorded during the displays occurring in the interval from the end of January to about the middle of March does not necessarily prove that the radiant point is more rich in fire-balls at that time than at an earlier period of its manifestation. The position of the shower must render it invisible until near midnight in November, while in January, February, and March it will be above the horizon nearly all night, and its favourable aspect in the evening sky enables it to command a large number of observers for its most striking meteors. In November such a shower would obviously escape the notice of all but those who extend their watches into the morning hours. I mention these circumstances to show that the foremost showers from Sextans may probably have greater strength than the observations indicate, though it has never been satisfactorily gauged.

A display which I saw during the two hours after midnight, on December 8th, 1877, was judged to be one of considerable importance. But from the perfect labyrinth of streams abounding in almost inextricable confusion of arrangement along the Earth's path, and in view of the difficulties inseparable from trustworthy determinations of intensity and epoch of individual systems, we may well be content for the present to point out such instances as deserve, as they will doubtless receive, further recognition at the hands of those observers who may hereafter apply themselves to investigations of this kind.

Bristol, 1884.

III. MORAL EPIDEMICS AND CONTAGIONS.

(Concluded from page 576.)

ON the contrary, do we wish to struggle against sadness? Then joyful countenances, brisk conversation, and gay songs will aid us in escaping from that state, just as in the above-cited example sound-waves assist us in

moving. Hence they please us, and easily become contagious.

Meanwhile, though at the first outset we may feel an extreme repugnance at feeling ourselves invaded—so to speak—by an expressive movement against which we are contending, yet on frequent recurrence this repugnance diminishes and disappears, when of course we give way to the external impulse. This has been already amply demonstrated.

If movements expressive of improper or criminal actions are communicated to the brain of persons present, those who are inclined to such actions will feel satisfied and will be easily carried away, whilst indifferent spectators will be more or less shaken. Good men will be wearied and revolted by the movement which seeks to invade them. Evidently such persons will not readily receive the contagion. Still in the long run, as in all other cases, these persons will more or less submit to the influence if they are not upon their guard.

These facts, if well understood and carefully analysed, yield a signal confirmation of M. Rambosson's law. We see very distinctly two movements contending in opposite directions; the movement coming from a foreign brain seeking to invade every brain which it can reach, to determine a reflex contagious action and to impose itself upon the *ego*, and, on the other hand, the *ego* which resists by an opposite action.

In a word, we easily see why some given expression may please and soothe us at one moment and displease and weary us at another; why it may be useful under certain circumstances and harmful under others, and why it may in different cases be more or less contagious.

These considerations will go far to explain not a few moral and social phenomena. We can now understand the influences—good or evil—of example and companionship, and see tangible reasons for avoiding scenes where our principles may be endangered.

We have already referred, in passing, to the relations between a public speaker and his hearers. We have seen why some men can take an audience as it were by storm, whilst their arguments, if taken down *verbatim* and quietly read over, are found impotent and worthless. In the former case any candid or impartial hearer who happens to be present is exposed not merely to the impulse derived from the brain of the speaker, but to that emanating from sympathetic hearers. Consequently to retain an even balance of

mind is no easy task. But there is here one point which M. Rambosson has overlooked,—a point in which moral contagions differ from physical epidemics. We know that in the one case, as in the other, persons of exceptional health and vigour, though exposed to the influence, come out unharmed. But healthy persons do not react upon a man suffering (say) from smallpox. His disease is not rendered either more virulent by their liability to infection, nor more benign by their immunity.

As regards moral contagions the case is different; persons may not only resist the movement, but may exert an opposing influence upon the brain in which it originated. Everyone must have noticed, or at least heard of, the different effects produced upon an orator according as he feels that his audience are with him or against him. In the latter case, even though there may be no overt expression of disapproval, yet the most hardened agitator feels his confidence diminish and his flow of sophisms become obstructed while suffering under stricture.

To take a case which we will not pronounce exactly analogous, let us turn to the records of spiritual manifestations. We find it stated, over and over again, that the presence of even a single obstinate sceptic prevented, or at least greatly limited, the phenomena which were expected.

Something similar occurs in cases of so-called magical or miraculous healing. Want of faith is declared a fatal obstacle. But if the views of M. Rambosson are correct, faith is simply a ready accord between the brain-movements of the operator and those of the patient. Knowing the various influences of the nervous system upon the entire living animal, we need feel little surprised that a physician who feels perfect confidence in the plan of treatment he is adopting, and who can impress that confidence upon his patient,—*i.e.*, who can induce in the brain of the latter a movement synchronous with that existing in his own,—should be eminently successful.

Turning once more to public meetings as the great means, in this country at least, for the propagation of moral contagion, we have often—on analysing the arguments of some agitator, and pointing out the baselessness of his premisses and the falsity of his conclusions—been met with the remark, "Yes, but you should hear him!" We reply, "No, my good friend: we are quite satisfied to read what he has to advance, without exposing our judgment to be warped either by the personality of the speaker or by the sympathy of his hearers." Facts, and legitimate inferences from facts,

can lose nothing by being written instead of uttered verbally. The moral is that those wish to judge a righteous judgment should eschew public meetings.

It will be seen, from what has been said, that the will may intervene either to resist or to assist a reflex contagious movement. It may either resist such movement entirely or partially, to a greater or less extent, either neutralising or developing the influence from without.

Further, we find that what the will has realised often, and in a conscious manner, may fall under the domain of the instinctive. We come to do instinctively that which, by the original instinct of the will, has passed into the sphere of habit.

We find likewise that actions which inspire fear may, up to a certain point, prevent or restrain the contagion which we are discussing, by determining the will to struggle against the reflex movement.

The facts which experience reveals are perfectly in harmony with theory, and with the consequences of the law laid down.

Hence it follows that whatever enfeebles the will renders the contagion more powerful. Children and idiots can oppose merely an instinctive resistance, and are more susceptible than rational men.

It is easy to understand that persons whose nervous system is weak, and at the same time very sensitive, very easily impressed, may be more easily led into these contagious reflex actions, as indeed into reflex actions in general.

There are likewise persons who have a natural predisposition to certain reflex actions, and whose will to resist is either almost null, or who at least have not been trained to exercise this faculty. Here again are causes which render reflex action more easy and more energetic, and which consequently promote the contagion with which we are engaged.

It is easy to see that such predispositions may be acquired by exercise and habit, and it is even proved that when once acquired they may become hereditary.

Hystero-epilepsy, and the phenomena at once so strange, so delicate, and at the same time so complicated, by which it is accompanied, have been placed in a full light by Dr. Charcot. It may even be said that the distinguished professor of clinical medicine at the Salpétrière has left nothing obscure in this region. In order to be convinced of this it is merely requisite to attend his lectures. The profound studies which Rambosson has made in this direction have

shown how these morbid conditions where the phenomena are isolated, restricted, or exaggerated, according to circumstances, corroborate the law of the transmission and transformation of the expressive movement and of the reflex action to which it gives rise, whilst at the same time the law gives the reason of the phenomena.

By generalising these notions, which are very simple, we may explain all those apparent contradictions which the contagion of nervous phenomena may present, and reply to all objections which may here be raised.

We will confine ourselves here to recall to mind that the law of the transmission and transformation of expressive movement as expounded above proves to be of an unexpected fecundity, for it explains the propagation to a distance, and the contagion of all the phenomena, all the affections, which have a cerebral movement as their point of departure.

Further, by showing that a cerebral movement is transmitted from brain to brain without losing its nature, and that to an identical or analogous cerebral movement there correspond identical or analogous phenomena, psychological and physiological, we have given the strictly scientific solution of a great number of problems which have hitherto been considered as inexplicable, and which have been banished into the most abstract regions of Philosophy,—such as the essential character of natural language in man and in other animals; the reason of its spontaneous comprehension, at all times and in all places; the special character of conventional language and its properties; the reason of the spontaneous comprehension of music and of all the fine arts; the nature and the explanation of their influence, physical and moral; and their part in hygiene and in therapeutics.

This law is founded upon no hypothesis, but upon a rigorous scrutiny of facts. The author claims the right of insisting on this point, since he has been so scrupulous as not to touch upon many questions which he is persuaded belong under this law, such as most of those which have reference to animal magnetism and to somnambulism. He has observed this precaution in order that the obscurity which rests on these subjects may not give a pretext for misinterpreting the facts which he has brought forward.

We may now proceed to a general summary. In order to demonstrate the principle of the contagion of nervous phenomena, intellectual and moral, it has been necessary to

establish as preliminaries certain points which are based upon the most advanced data of different sciences.

1. In our studies the grand problem of the transformation of motion has taken, we believe, a step in advance. We have proved that the transmission and transformation of motion may be effected in a number of cases, and in particular in the cases in question, without the movement losing its co-ordination. On being transmitted to different media, cerebral or psychic, then purely physiological and physical, then again physiological and psychic or cerebral, it presents in the different media different phenomena, but on repassing into the same medium it reproduces the same phenomena—the movement appears co-ordinated in the same manner. We are, indeed, thus led to ask if the mythic Proteus does not symbolise knowledge formerly possessed, then lost, and finally re-discovered.

2. On accurately summing up the most recent physiological discoveries we are necessarily led to consider the organisation, in its most general functions, as being merely a conductor and transformer of motion, and to find that we only reach the *sensorium commune*, the *ego*, by motion, and that the *ego* only manifests itself or responds by motion,—a motion special and co-ordinated for each phenomenon. When the organs are diseased they affect the nature and the conductivity of this movement in different manners. Hence the perturbation remarked in the psychic phenomena.

3. We have brought the fact prominently forward that to a given cerebral movement there always correspond identical and analogous phenomena. Thus the cerebral movement which produces laughter is not the same as that which gives rise to yawning, &c.

4. The cerebral movement transmitting itself from brain to brain, through the ambient medium, without losing its nature, must consequently reproduce—or tend to reproduce—in any other brain which it reaches all the phenomena which depend upon it in the brain where it originated.

5. The ordinary ambient physical medium which serves as intermediary for a cerebral movement in passing from one person to another are the sonorous and the luminous vibrations. [Also the olfactory movements ?] We have studied the movements, and the relations of these various waves, and found that they concur perfectly in the reproduction of the same phenomena,—that they may act separately or simultaneously, in spite of the difference in their nature and the diversity of their rates of movement. They are added together when they act simultaneously to reproduce

one and the same cerebral movement, and consequently the physiological phenomena dependent thereon. The author has left no obscurity in this demonstration, which is of a twofold nature, being founded firstly on direct observation and experiment, and secondly on careful studies made upon blind or deaf persons.

6. Thanks to the facilities which Science now places at our disposal, we can follow the cerebral movement from stage to stage without losing sight of it for a moment, and can demonstrate its identity.

7. Just like the nervous phenomena with which we have been occupied, intellectual and moral phenomena are only manifested at first by cerebral movements, the brain being the seat of all the psychic faculties ; this, being scientifically established, cannot be contested by anyone. Hence it follows that the phenomena due to these faculties become contagious by the propagation of the movement which is peculiar to each of them, and which passes from brain without losing its nature. They all come consequently under the same law of propagation, whatever may be the difference of nature observed among them.

8. We have seen that the cerebral movement is, as regards psychic operations, *sometimes cause and sometimes effect.* It is the *cause* when it is produced by an external movement. By acting on the psychic faculties it gives rise to sensation, perception, &c. It is *effect* when the *Ego* acts or reacts,—when it thinks, loves, wills, &c.,—in a word, when it acts in any manner whatsoever. It produces then a cerebral movement which is propagated outwardly, and which reveals what is passing within.

9. When the reproduction of the phenomena which occupy us takes place, as it is determined by the movement which passes from brain to brain, there is then a reflex action,—the movement from centripetal becomes centrifugal. It is therefore this direct action which is the *immediate cause* of the contagion which we are studying.

10. This reflex action is distinguished from every other because the origin of the physiological movement which gives rise to it is found in a foreign organism, whilst ordinary reflex action is produced by a centripetal movement having its physiological source in the same person in whom the action is manifested. This indirect reflex action—*in Distans*—is then very remarkable for the origin of the movement which determines it, and must be specially distinguished from every other.

11. If we study with care the circumstances which are in connection with that reflex action which produces contagion, we see that some of them are common alike to it and to direct or ordinary reflex action, whilst others are peculiar. Here are some of the conclusions at which the author has arrived on this point :—

The reflex movements which produce contagion are sometimes conscious, sometimes unconscious. They may be automatic, instinctive, or, on the other hand, conscious and voluntary. They may even sometimes change their nature, passing from the instinctive to the conscious and voluntary, or inversely.

Various simultaneous or successive movements may be produced in an assemblage of individuals, and may give rise to reflex movements concurring to some common object. In the military state especially these facts may be produced in a signal manner.

A contagious reflex movement under the influence of the same causes is not produced equally and always in all persons. We have explained these facts, as well as the influence of repetition upon reflex action.

Furthermore, one and the same reflex action may, according to circumstances, produce effects quite opposite. We have cited above certain instances, such as the sound-waves of a military march ; the action which they tend to produce aids those who have to act by saving them the fatigue of a direct movement, and wearies those who wish to remain quiet by compelling them to resist the reflex action. By generalising these diverse and opposite actions of one and the same contagious reflex movement, it is easy to explain scientifically all the apparent contradictions observed in nervous, intellectual, and moral contagions, and to throw a light upon the most obscure points.

12. By following out this order of ideas it is easy to see that man is not subjected by necessity to the contagion of the phenomena in question, but that by a direct movement he can struggle against the contagious reflex action, and may either neutralise it in part or completely, or, on the other hand, may allow it to become developed.

IV. THE PROPOSED AMERICAN EXHIBITION IN LONDON."

By an Old Technologist.

" Competition, in the sphere of industry and commerce, has become a war to the knife."—*Kölnische Zeitung*.

THAT a nation should get up a display of its own products, whether natural or manufactured, is in these days an event common almost to staleness. But to hold such an exhibibiton, or "exposition" as it is termed, of writers of un-English in a foreign country, is indeed original. But, though by no means wedded to precedent—to old use and wont—I cannot look upon this innovation in the light in which it is viewed by no small portion of the British press. To prevent misconceptions, or rather misinterpretations, let me say that, as far as science is concerned, I am a complete cosmopolitan. In that field the rivalry between different nations seems to me perfectly honourable, and even friendly. Thus, while regretting that Germany produces a greater quantity of research than does Britain, I wish not that she should do less, but that we should do more. I hailed the proposal, which has been successfully carried out, of holding this year's meeting of the British Association across the Atlantic. If Captain Bedford Pim's suggestion that in 1887 the American Association should meet in London becomes a reality, no one will rejoice more sincerely than shall I. And if an International Association is formed I shall be still better satisfied.

But between science and what is commonly, though not happily, termed applied science, there is a heaven-wide gulf, so that from the one we cannot argue to the other. Applied science, or rather industrialism, is now more and more plainly becoming merely a phrase of war. Indeed, no small part—and, I fear, an increasing part—of its energies is now turned towards "improvements" in the art of "war," taking that term in its old and narrower sense. But if we define "war" as any process by which one nation seeks to injure another for the sake of some real or supposed benefit to itself, we shall find that modern industrialism is war all over.

Time was—or rather, perhaps, certain amiable enthusiasts such as Elihu Burritt, dreamed of a time when commerce, based upon the division of labour, should be a bond of union between nations, the prosperity of one being essential to the well-being of its neighbours. It was supposed that one people might say to another, "I have a fertile soil and a genial climate. I do not care to live cramped up in cities amidst the dust and dirt and din of manufactures; let me, therefore, supply you with corn and fruits, wine and oil, healing drugs and dye wares, whilst you in return furnish me with hardware and clothing, glass and pottery."

This spirit, if ever it existed, has almost entirely exhaled. Almost every nation aims at being entirely self-supplying at once with raw materials and with manufactured goods. In order to exclude foreigners from its markets, as sellers, it is even willing to pay a notably higher price for many of the requisites of civilized life, thus paying what may be called a subsidy to its manufacturers and a kind of poor's-rate in augmentation of wages to its workmen.

Into the wisdom or folly of these arrangements it is not the place of the "Journal of Science" to enter. A nation may, perhaps, find it advantageous to bear severe losses and sufferings in the hope of inflicting severer losses and sufferings upon a rival. This is the very *rationale* of war, and I notice it merely to show how completely modern competitive industrialism is, in its very essence, war!

In their endeavours to exclude foreign goods from their markets the United States have been more systematic and more determined than perhaps any other nation. They are the champions of protectionism as decidedly as Britain has been the representative of free trade. Perhaps it may be said that they legislate for the world as they find it, whilst we are given to regulate our laws and our institutions in accordance with some Utopia existing only in the dreams of orators. Be this as it may the United States even impose taxes on foreign scientific books and journals, lest the American paper maker, printer, &c., should suffer some infinitesimal loss by being thus exposed to a fractional competition with European countries. And such taxation still finds its advocates in a country where the revenue shows no signs of falling off.

American protectionism, moreover, seems to be especially directed against Britain. If we read the many flourishing trade journals published in the United States we cannot fail to be struck with the bitterness of spirit in which the question of free trade *versus* protectionism is discussed. To

supplant British manufactures at home and abroad is one of their chief objects, and every step taken in that direction is the subject of no little jubilation. If anyone doubts this he need merely glance over the American papers representing the paper trade, the chemical, textile, iron, and glass manufactures, &c.

At the same time, curiously enough, what is sauce for the goose is not accepted as a legitimate sauce for the gander. It is all right and proper for European products to be excluded from the American market, but legislation for the exclusion of American bacon and hams from the European continent on account of the alleged presence of trichinæ gave rise to much ill-feeling in the United States.

Still such inconsistency is a part of human nature in all countries. I once met with a Midland farmer who was indignant that French butters should be sold in England as "genuine Aylesbury." At the same time he could see nothing objectionable in condensed "Swiss milk" manufactured at Aylesbury.

With reference to this threatened exhibition, it should always be borne in mind that in these great advertising displays all nations do not stand on an equal footing. A free-trading people is heavily handicapped in comparison with a protectionist rival. The protectionist, if he sees anything desirable in a foreign display, does not seek to import it, for his tariff laws may make that commercially impracticable. He seeks, instead, to introduce its manufacture into his own country. On the contrary, if he can show anything desirable to free traders they are willing and able to buy it. Hence a free-trading country has much to lose and little to gain by exhibitions, especially if it makes a display not merely of finished goods but of the machinery and the processes by which they are produced.

There is another inequality between the free-trader and the protectionist which, at an exhibition, tells heavily against the former. He has to produce his goods—say printed calico—"at a price," as the trade expression runs. Hence he is often debarred from using the best materials and employing the greatest skill. He is sometimes even debarred from experimenting by the same condition. On the contrary, the protectionist can get his own price, can thus afford to employ superior materials and a higher class of labour.

These incidental drawbacks of free trade in connection with exhibitions have not, I believe, received the attention of economists. But they are, in my opinion, sufficient to

place Britain in a disadvantageous position as regards international displays, and to make them, for us, undesirable. But still less desirable is the proposed gathering. The "British Trade Journal" goes so far as to remark, "There may be, in a few quarters, remarks as to the illogical position of a country which maintains prohibitive tariffs and endeavours, at the same time, to find a market for its productions abroad; and it may even be asked if the United States wish us to take not only their corn and their fruit, but also their manufactured goods, what, in the name of all that is reasonable, are they going to take in return? This is a question which such an exhibition as that proposed will assuredly bring up." That a trade which it is sought to make entirely one-sided must come to an end needs no demonstration. If we cease to be producers, or what amounts to the same thing, if no one will buy our products, we must perforce cease to be consumers. There are some persons who calculate that if our foreign commerce goes on declining at its recent rate for twenty years longer, it will have reached not the beginning of the end, but the end itself.

After these preliminary considerations, I come to the two main questions, viz., what are the objects which the United States have in view by the proposed exhibition, and what is the especial time which they have selected?

It is expected, we read, among other things, to "stimulate emigration to the United States." It is to be an "encouragement to the emigration of the better class of English farmers, very few of whom have yet come to this country (America) and who would better themselves by coming, besides being very desirable citizens." "It will," says General C. B. Norton, the chief promoter of the scheme, "if properly managed, largely encourage immigration." "This," says the "Manchester Textile Recorder," will be an immense advantage to the crowded population of this overcrowded country, who must eventually seek in other lands the means of subsistence they are unable to obtain here."

Many more similar admissions might be quoted, were it needful, to prove that the drawing off to the United States of a portion, and that not the worst portion, of our population, is one of the cardinal points aimed at.

But another mark is British capital. Says one paper, "Capital is seeking for new outlets, and if it can be shown that there is a profitable return, in land transactions and industrial enterprises in the far west, there is little doubt that investments will be readily made."

"To our mind," says an American organ—not one of those dreadful parlour organs which make life not worth living in the two next houses—published in London, "the most important section of this exhibition will be that devoted to showing the advantages of the newer states and territories for the investment of capital." Again, "through this presentation the attention of foreign capital will be attracted to the great railway and mining interests of this country." Passages of similar nature might be multiplied indefinitely, all tending to show that *a* great, if not *the* great, object in view is the attraction of British capital.

The third great object of the promoters is to increase the sale, not so much of American raw material as of American manufactures. Says one American authority, "There can be no better way possible for American producers to introduce certain lines of goods to the British public than through a great exhibition devoted entirely to American products to be held in the metropolis of Great Britain." One American paper writes, "It would open up for us new and profitable markets." Another thinks "the enterprise will have a tendency to open up markets for us in Europe." A third considers that "it cannot fail to be of great advantage to our industries and lead to an increase in our export trade."

An English paper which decidedly favours the scheme writes, "The Americans have everything to gain from such an exhibition." This I shall not dispute; but suppose that the intended demonstration should be successful, what have we to gain or to hope? I shall, of course, be censured for thinking, at such a juncture, of so despised a matter as "British interests." But how will they be affected? Can American manufacturers and merchants do more business in this country without depriving British manufacturers and merchants of some part of their business? and is this to be desired? If the United States were a free-trade nation I might be told in reply that the more of their produce the Americans can sell in Britain the more of our manufactures they will buy in return. But they are not free traders, and they are constantly seeking to still further lessen their imports of British goods. Hence I see but scanty hope that any increase of trade between Britain and the United States will be other than one-sided.

I must now turn to the other two purposes of the Exhibition, the attraction of British emigrants and of British capital to the American Union, and ask how far these aims are compatible with our national interests? It must be

freely admitted that, as the "Manchester Textile Recorder" has it, we have a population "in this over-crowded country who must eventually seek in other lands the means of subsistence they are unable to obtain here." It may also be true that there is British capital which is unable to find remunerative investment within the narrow limits of the United Kingdom. But does it follow that either our surplus labour or our surplus capital must be drafted off to America? This consideration brings us to the particular point of time selected by General C. B. Norton and his colleagues for their undertaking. We all know that it has been officially announced through H.R.H. the Prince of Wales that in the year 1866 there will be held at South Kensington an exhibition for bringing before the home-public the productions and the resources of those portions of the British Empire which we still call by the chilling names of colonies and dependencies, and which too few of us have yet learnt to regard as portions of our home, part and parcel of the birthright of the British people and their *socii*. The avowed purpose of this exhibition is to attract both capital and labour to Australia, New Zealand, South Africa, the Dominion, and capital, at least to India, the West Indies, &c. These regions are, taken collectively, far vaster than the United States, and certainly not inferior to them in the extent and variety of their resources. The objects of these two exhibitions are therefore diametrically antagonistic. The one is seeking to draw our labour and capital away to an alien land, whilst the other seeks to retain them within what is, strictly speaking, a part of our country. The American exhibition seeks to increase our (import) trade with the United States; the colonial exhibition seeks to extend both our import and export trade with the "colonies" and India. It is self-evident that the success of the one implies, *pro tanto*, the failure of the other. It is no less evident to which the sympathies of every true Briton must be given.

I do not know, and I have no right to assume, that the promoters of the American exhibition were already aware of an intended colonial exhibition when their scheme was first announced, in which case they would have been guilty of a grave act of international discourtesy. But in any case the coincidence is to be profoundly regretted, and I am far from concurring in the opinion of "The City" that England is "the most favoured nation," and that "we must consider ourselves very fortunate." All that remains is to strain every nerve to render the Indian and Colonial exhibition the more attractive and the more telling of the rival displays.

V. A NEW THEORY OF GRAVITATION.

By Robert Bell.

IT is with a great deal of reluctance that I lay before you an article which I hope (perhaps vainly) will enable Science to look into the secret chamber where gravitation has for so long a time concealed its mysterious power.

I say with reluctance, because if my theory of gravitation and planetary locomotion is correct it necessarily does away with former theories, admitted but not understood,

The force of gravitation is believed to be great, beyond the limit of human comprehension; but any effort to find it, to be successful, must be at the other extreme, because that power called Gravitation is in reality so small that it has hitherto escaped observation.

Be not startled, therefore, when I venture to assert that the Sun has no power in an attractive sense; that every cosmical body contains the means of its own locomotion; and that, although the Sun causes the Earth to describe a circle, instead of flying off in a straight line, it is done by quite a different process than by attraction. Let it be granted that Nature does all its work with the most simple means, and let us admit that weight gives motion,—that power is required only when there is resistance to be overcome; and let it be fair to assume that there is nothing where it cannot be proved that something exists: then if it is fair to assume that nothing exists where it cannot be proved that there is something, there is no universal atmosphere. If there is no universal atmosphere the Earth is suspended in absolutely pure space; and if the Earth is suspended in pure space there is no resistance to be overcome in putting it in motion: then it is plain that, if there is no resistance, an almost infinitely small power, if applied to it, would put it in motion. Now where are we to look for this small power? Revealed Science points the way.

There is no force without a corresponding reacting force. Experiments with the radiometer show that radiation is a force; consequently we find that power in the reacting force of its own radiations. If these radiations were perfectly equal, from every part of the Earth's surface, the reacting force would be perfectly equal also, and this would produce centripetal force, or what is called gravitation, by inclining

everything to its centre ; but the Earth itself would remain stationary. I have thus accounted for centripetal force : now where shall we look for centrifugal force ?

It is plain that, if the Earth's radiations were not perfectly equal all around, it would recede in the opposite direction to where they were strongest. Then comes the part the Sun does. The heat of the Sun destroys the evenness of the Earth's radiations by giving extra food for radiation, now at one part and again at another, thus giving it a forward motion without materially affecting its centripetal force.

We have only to look at the circular motion a billiard ball describes when struck on the side by an expert, or the elliptical orbit pursued by a ball on the bowling alley, when thrown by a master hand, or even the peculiar course followed by the boomerang as it speeds along, its different sides ever changing their relation to the surrounding atmosphere.

We have only to look at these to get at least a vague idea how the Earth describes a circle by means of its varied radiations. While the reacting force of the planets' radiations perform the functions above described, *their* radiations have a part to perform. These radiations prevent them coming into collision by repelling each other.

Thus we see the wisdom of the Creator, who doeth all things well. The bodies of the universe are all a piece of perfect machinery, made by a master hand, and do not require to be watched or wound up to keep it in order.

VI. MR. S. BUTLER'S CONTRIBUTIONS TO THE QUESTION OF EVOLUTION.

OUR readers may remember that we have on former occasions noticed some of the works of Mr. S. Butler —too favourably if we may judge from certain letters of remonstrance which we have received. The time has now come when an estimate of his services or disservices, as regards the great theory of Evolution, may be fairly attempted.

It need be merely mentioned that Mr. Butler, though a decided Evolutionist, is an equally decided rejector of the principle of Natural Selection. This rejection he has recorded in very plain language, going so far as to assert that Mr. Darwin and his colleagues and followers have left the doctrine of Evolution in a less intelligible state than they found it. He traces instinct—not unhappily—to inherited memory. He makes a great point of the distinction between conscious and unconscious knowledge, asserting that so long as we are conscious of our knowledge such knowledge is imperfect.

Passing over many other instances adduced as illustrations, we will select the following in virtue of its familiarity:—"Taking, then, the act of playing the piano as an example of the kind of action we are in search of, we observe that a practised player will perform very difficult pieces apparently without effort,—often, indeed, while thinking and talking of something quite other than his music. . . . He finds it difficult to remember even the difficulties he experienced in learning to play. A few may have so impressed him that they remain with him, but the greater part will have escaped him as completely as the remembrance of what he ate or how he put on his clothes this day ten years ago; nevertheless it is plain that he does in reality remember more than he remembers remembering. . . . We draw the inference, therefore, as regards pianoforte or violin playing, that the more the familiarity or knowledge of the art (mark the term art!) the less is there consciousness of such knowledge. . . . On the other hand, we observe that the less the familiarity or knowledge the greater the consciousness of whatever knowledge there is. Conscious knowledge and volition are of attention; attention is of suspense; suspense is of doubt; doubt is of uncertainty; uncertainty is of ignorance; so that the mere fact of conscious knowledge or willing implies the presence of more or less novelty and doubt."

It may here be objected that Mr. Butler is confounding two different kinds of knowledge, or rather two things which are unfortunately confounded under the term "knowledge." There is the knowledge which expresses itself in art, and which may and does become unconscious as it reaches perfection. There is the knowledge which when organised becomes Science. And these two are not one.

It is a fearful mistake to assert even that, in the sphere of practical art, if a man can do a thing he knows how to do it,—*i. e.*, that he knows the principles upon which it is

done. Let us take an instance which has in former days come under our personal observation. Here is G. K., blue-dyer at the Dash-wheel Works. He can set a warm-indigo vat and work it, turning out well-dyed cloths, rarely making a mistake, and keeping his vat in good working order. But does he know the principle of any one step in the process? Did he ever know it? Did the master to whom he was apprenticed ever know it, or his forerunners back to the earliest times when indigo-vats were worked in ancient India? Most emphatically no! He knows nothing of the transmutation of indigo-blue into indigo-white, or by what agency it is reconverted into indigo-blue after being deposited on the fibre. He knows by odour and colour when his vat is working right, and when it is sick; but he never thinks that the right and the wrong conditions are due to the action of certain ferments, and that it is possible to cherish the one and to repress the other. Lastly, not to prolong this illustration, he can, if he has had a quarrel with his employer, occasion much trouble by throwing lumps of copper sulphate into the vats. But he has not the faintest idea how this mean piece of rattening acts. He does not know that salts of copper have the power to transfer oxygen from the atmosphere to organic matters with which it is in contact, thus converting the soluble white indigo into the insoluble indigotine, when it has no longer the power of attaching itself to the wool.

Lastly, it is well known that in the art of indigo-blue dyeing, as well as in dyeing cochineal-scarlets, a variety of improvements have been made. The process has been simplified, and a variety of useless ingredients have been omitted. But has this ever been done consciously, or with increasing perfection has it come to be done unconsciously? We trow not: a number of fortuitous steps—very much as in the supposed formation of species by Natural Selection—have led up to the present state of the art. Some one of the useless ingredients was accidentally omitted, or the supply fell short, and the dyer, going to work without it, obtained as good a result as if he had followed the old traditional receipt. But why this or that ingredient was needless he never asked. There was also in dyeing, as in other arts, experimentation, but it was a blind tapping,—again like the action of Natural Selection.

But when a really great improvement was needed, men of conscious knowledge were needed. Schützenberger and De Lalande discovered a process by which oxygen could be withdrawn from organic matter, both efficaciously and regu-

larly, without the complex and often apparently capricious action of ferments. It struck them that this process might be applied in indigo-blue dyeing, and they succeeded, rendering the process henceforth easier and more economical.

In like manner it might be shown that the chief improvements in other arts have sprung from those whom the world calls "men of Science," but to whom Mr. S. Butler refuses that title. Indeed it seems scarcely uncharitable to suggest that Mr. Butler would never have launched into his depreciation of conscious knowledge, save with a purpose—perhaps scarcely conscious—of dealing a side-blow at the scientific world, with whom his relations are not too amicable.

Let us, for instance, weigh the following passages:—"Our conception of the words 'Science' and 'Scientific' must undergo some modification. We should recognise more distinctly than we do that there are two distinct classes of scientific people. . . . The one class is deeply versed in those sciences [it should be *arts*] which have already become the common property of mankind; enjoying, enforcing, perpetuating, and engraining still more deeply into the mind of man acquisitions already approved by common experience." ["Enforcing, perpetuating, and engraining"—the work of the pedant.] . . . "While the other class is chiefly intent upon pushing forward the boundaries of Science, and is comparatively indifferent to what is known save in so far as necessary for purposes of extension. . . . Surely the class which knows thoroughly well what it knows, and which adjudicates upon the value of the discoveries made by the pioneers,—surely this class has as good a right, or better, to be called scientific than the pioneers themselves." The author is here, surely, carrying his love of the paradoxical to an unwarrantable extent! But we find something yet more deplorable to follow. Mr. Butler thinks that the class whom he designates "scientific people" are "neither progressive nor aggressive, but quite peaceable people, who wish to live and let live as their fathers before them. . . . Others, whose services in this last capacity [discovery] have been of inestimable value, are noticeably ignorant of the sciences which have already become current with the larger part of mankind,—in other words, they are ugly, rude, and disagreeable people, very progressive, it may be, but very aggressive to boot."

It would be difficult to imagine a wider departure from the truth. The man of pure Science is of all men the least aggressive. So long as you do not deprive him of time and materials he will never interfere with you or your ways.

On the contrary, the other portion of mankind, who enter into the race for wealth or power, are *not* willing to live and let live. It is they who are the invariable and necessary aggressors.

We now come to the error, as it seems to us, which underlies Mr. Butler's whole scheme of evolution. He writes:—"A man shows that he knows how to throw the boomerang by throwing the boomerang. No amount of talking or writing will get over this." On the contrary, it is easily got over; the fallacy lies in the double sense of the word "*knows*." Mr. Butler continues, "*ipso facto,* that a baby breathes and makes its blood circulate, it knows how to do so!" Now, if we compare this case with that of the violinist we see at once a world-wide difference.

The violinist may be able to execute a difficult piece of music without conscious effort, automatically. But we know that there was a time when every note cost him a conscious effort. As regards the young animal, Mr. Butler admits that "it is less obvious when the baby could have gained its experience, so as to remember exactly what to do." We go much further; the baby can never have had a conscious knowledge of the processes of breathing or circulation, either in its own person or in that of its ancestors, human, semi-human, or brute.

We now come to the question of teleology. In opposition alike to Charles Darwin, along with most modern biologists, on the one hand, and to Paley and his admirers on the other, Mr. Butler admits "design," but maintains that "the design which has designed organisms has resided in and been embodied in the organisms themselves.

This view, he contends, was first suggested by Buffon, improved and made "almost perfect" by Erasmus Darwin, and borrowed from him by Lamarck, "though somewhat less perfectly comprehended by him than it had been by Dr. Darwin."

But how does he, an evolutionist not unversed in the truths revealed by embryology, succeed in saving the "design" idea at all? For he quotes that passage in which G. H. Lewes not merely crushes, but absolutely decomposes, Paley:—"None of these phases have any adaptation to the future state of the animal, but are in positive contradiction to it, or are simply purposeless; whereas all show stamped on them the unmistakeable characters of ancestral adaptation and the progressions of organic evolution. What does the fact imply? There is not a single example known of a complex organism which

has not been developed out of simpler forms. Before it can attain the complex structure which distinguishes it, there must be an evolution of forms similar to those which distinguish the structure of organisms lower in the series. On the hypothesis of a plan which prearranged the organic world nothing could be more unworthy of a supreme intelligence than this inability to construct an organism at once, without making several previous tentative efforts, undoing to-day what was so carefully done yesterday, and repeating for centuries the same tentatives in the same succession. There is a traditional phrase much in vogue among anthropomorphists which arose naturally enough from a tendency to take human methods as an explanation of the Divine—a phrase which becomes a sort of argument —"The Great Architect." But if we are to admit the human point of view, a glance at the facts of embryology must produce very uncomfortable reflections. For what should we say of an architect who was unable, or obstinately unwilling, to erect a palace except by first using his materials in the shape of a hut, then pulling them down and rebuilding them as a cottage, then adding storey to storey and room to room, *not* with any reference to the ultimate purposes of the palace, but wholly with reference to the way in which houses were constructed in ancient times. . . . Yet this is the sort of succession on which organisms are constructed. "The embryo is nothing like the miniature of the adult. For a long while the body, in its entirety and in its details, presents the strangest of spectacles. Day by day and hour by hour the aspect of the scene changes, and this instability is exhibited by the most essential parts no less than by the accessory parts. One would say that Nature feels her way, and only reaches the goal after many times missing the path."

Yet, in the face of this utterly overwhelming argument, Mr. Butler still believes that the "evidence for design is not affected. He gives a counter-illustration—quite incapable of being supposed—of a law deed which the draftsman had commenced as a marriage settlement and then converted into a will, and which yet was found to *work with ease and simplicity in practice* (!) And he thinks that an observer "would not, in the face of the result, deny the design." Yes; he would conclude that the draughtsman was either mad or drunk, certainly not guided by any rational purpose. In the words which we have italicised the question is in some sort begged. For if we turn from embryology to morphology we find that the result, *i.e.* the human system,

is not satisfactory. What of the vermiform appendage of the cæcum, which answers no purpose save occasionally to produce a painful death. What, above all, of the many points in which, as Dr. Clevenger has shown (see "Journal of Science," March, 1884, p. 134), the adaptation of man to an upright attitude is far from complete? Surely such facts put design out of court, and leave merely a something which to us—who are designers—simulates design.

VII. THE SIGNIFICANCE OF HUMAN ANOMALIES.

By Francis J. Shepherd, M.D.

[The following article, communicated by its author to the "Popular Science Monthly," forms such an important contribution to the evidences of Evolution that we think it our duty to lay it before our readers.]

EVER since the study of human anatomy has attracted any attention, variations in the arrangement of the different structures of the body have been noticed. For many centuries the signification of these variations was not understood; and even as lately as 1840 Dr. Knox, of Edinburgh, who had the courage to state his conviction that they connected man with the lower animals, was looked upon, even by members of his own profession, as one prompted by the evil-one. In early times, when great prejudice existed against the dissection of human bodies, and animals, such as monkeys, dogs, cats, &c., were frequently used as substitutes, the similarity of some of their muscles to those which occasionally occurred in man as anomalies forced the anatomists to remark on them as being curious coincidences, though in their published works they drew no conclusions from their occurrence bearing on the origin of man.

In the view of our present knowledge of the animal kingdom and its development, and with the acceptance of the

great principle of Evolution, the explanation of these variations is simple enough, *viz.*, that they point to the fact that man has descended from some lower form, and "is the co-descendant with other mammals of a common progenitor" (Darwin).

Again, many structures which in man are merely rudiments and quite useless, nay, sometimes a source of danger, are seen fully perfected in some of the lower animals, and in them fulfil a definite purpose. The existence of such rudimentary organs (or, as Haeckel calls them, "worthless primeval heir-looms") as the ear-muscles, the appendix vermiformis in the intestines, the thyroid gland, the remnant of the third eyelid, the rudimentary tail-bones, and many others, is not satisfactorily accounted for on the theory of the plan of general unity; but if we look upon them as parts which have become functionless and atrophied from want of use, and by heredity have been transmitted from generation to generation, a bright light is thrown on the reason of their existence. In the present paper I do not intend to dwell on the significance of rudimentary organs which exist normally in man, but shall confine myself to those structures which occur as variations.

I might here mention that some parts, as for instance certain muscles of the thumb, occur in man, but not in the lower animals; these we may take as indications of the advance of man to a still higher development.

To the study of embryology we owe much in elucidating many morphological problems, and removing others from the domain of theory. By our knowledge of this most intricate subject the significance of many variations and rudimentary organs is made plain.

It has been well said that "the development of the individual is the compressed development of the race in the process of compression; some features are suppressed or modified, and others are thrown into relief." In the development of the embryo we see the history of the race, but the higher the form the more quickly does the embryo pass through those stages and transformations which are the equivalent of what is persistent in types below. In lower forms these stages are much less rapid, and in fact are true metamorphoses. The changes occurring in the development of the common frog will furnish a familiar example of this latter statement. The more we know of embryology the more the truth of the saying that "development means descent" is apparent.

It may not be generally known that no two individuals

have exactly the same anatomical structure, and that nearly everyone has in him some bony prominence, supernumerary muscle, or abnormal blood-vessel, which tells the tale of his descent. During the past nine years I have been teaching anatomy, and nearly three hundred subjects have been dissected under my immediate supervision: in these I have carefully noted the variations occurring, with the result of finding that scarcely one body is perfectly normal in every part,—nay, many are very abnormal, having as many as thirty to forty variations in their bones, muscles, or arteries. I have found variations to occur more frequently in Negro and Indian subjects than in those of European descent. When a variation in a bone, muscle, or blood-vessel is found, the first question asked is, What is its morphology? and it is the exception not to be able to make it out; if one fails it is concluded that our knowledge is deficient, and that the variation has a history, if we could only discover it.

Many variations are explained when an appeal is made to comparative anatomy, a science which is as yet very incomplete, but which is rapidly enlarging its boundaries. Some animals we know by their fossil remains, and in these merely their bony structure can be studied; all the soft parts are, of course, lost for ever, and can only be approximately restored by our knowledge of allied existing types of the same animals. With these few preliminary remarks I shall proceed to describe, as simply as possible, some anomalies I have myself met with, and the significance of which I shall endeavour to make clear.

Osseous System.—In a skull in my possession, whose lowness of type is manifested by the narrow forehead, prominent supra-orbital ridges, wide arches of bone to inclose the large masticatory muscles, the acute facial angle, prognathous jaws, and well-marked bony prominences, are two remarkable variations:—

1. An Epihyal Bone.—In all human beings there is near the ear-opening a bony spine, generally about half an inch long, and which is called, from its resemblance to an ancient pen, the styloid process; the lower end of this is connected with the hyoid or tongue-bone of the neck by a fibrous cord. Now, in this skull the styloid process is not connected with the little tongue-bone by a fibrous cord, but the styloid process is itself prolonged down to the tongue-bone and articulated with it in the fresh state. It is quite a large bone, $3\frac{1}{2}$ inches long. This arrangement is seen in many of

the lower animals, and in them the bone, which is a very important one, is called the *epihyal bone.*

2. At the base of the skull on the left side, behind the mastoid process, the prominent nipple-shaped process behind the ear, is a stout, bony spur, more than three-quarters of an inch long, which has a downward direction, and articulates with the first bone of the vertebral column. This process is rarely seen in the human being, and is the only one I have met with, but it is quite the normal condition in most graminivorous and carnivorous animals, being especially well marked in the horse, pig, sheep, and goat. In them it is an important part, and gives attachment to strong muscles which move the head on the trunk. It is called the paramastoid process, from its proximity to the mastoid.

Supernumerary Ribs.—I suppose everyone is aware that the vertebral column, or backbone, is composed of many separate bones, some of which carry ribs. The backbone is made up of thirty-three bones,—seven in the neck, twelve in the trunk, five in the loins; below this we have a bone called the sacrum, which consists of five vertebræ fused together; and lower down still four small bones which represent the tail-bones, called, when taken together, the coccyx, from their supposed resemblance to a cuckoo's beak. Now each trunk, or dorsal vertebra, has two ribs connected with it, one on each side; so there are altogether twenty-four ribs, twelve on each side; but sometimes there are more, and, when this occurs, the extra ribs are carried by the neck (cervical) or loin (lumbar) vertebræ. I have specimens in my collection of both varieties, cervical and lumbar. These supernumerary ribs do not occur very frequently; still every anatomist has observed them. Their occurrence becomes more intelligible when we know that in crocodiles, birds, and the three-toed sloth, neck or cervical ribs exist normally; that in crocodiles, alligators, and some other animals, loin or lumbar ribs are never absent; and that in man traces of them exist in the muscles of the abdomen. In the human embryo, in an early stage, a rib is always seen connected with the seventh neck-vertebra, but before the fifth year of life it becomes blended with the ordinary transverse process; occasionally, however, this rudiment goes on developing, till it becomes a more or less perfect cervical rib.

Supra-condyloid Process.—It is not uncommon to find, in the humerus or arm-bone of a man, a hooklike process on the inner side of the lower end, having a downward direction:

this, with a band of ligament which connects its tip with the humerus lower down, forms a foramen or opening through which pass the great artery and nerve of the arm. This foramen is found in about 3 per cent of recent skeletons, but much more commonly in the skeletons of ancient races. In very many bodies a trace of this foramen is seen, represented by a very small bony prominence, or only by a band of fibrous tissue. In many of the lower animals it is the normal condition. It is seen in nearly all the Carnivora, except the plantigrades (though it has been found in the cave bear); it is also seen in monkeys, lemurs, and sloths. In these it is generally completed by bone, though in some by bone and ligament, as in man. In the animals above mentioned it serves the purpose of protecting the great nerve and vessel of the fore-limb from pressure during flexion, and it also affords a more direct course by which these structures can supply the parts below. In man when this arrangement occurs, owing to the altered position of the limb, the nerve and blood-vessel are actually dragged out of their course to pass through this opening; so in him it serves no useful purpose. This variation is, as was first pointed out by Prof. Struthers, well known to affect certain families. The only reasonable explanation of the occurrence of this structure appears to be that of reversion to the type of some mammalian ancestor in which this part was functional, or, in other words, served a definite purpose (Struthers).

Third Trochanter.—The third trochanter of the thigh-bone occurs about as frequently as the supra-condyloid process. On the upper part of the thigh-bone there are two prominences called the greater and less trochanter; a third prominence (*trochanter tertius*) sometimes occurs; it is situated a little below the great prominence, and gives attachment to the large muscle of the buttock (*glutæus maximus*). According to Fürst, in forty skeletons of Swedes examined by him in the Caroline Institute in Stockholm, fifteen possessed this process, and in six skeletons of Laplanders four had a third trochanter. I have seen it in only about 1 per cent of the skeletons I have examined. In many of the lower animals this process is enormously developed; it is very prominent in the horse and rhinoceros, and in many others it exists in a slighter degree.

One more example from the osseous system and I shall pass to the softer structures. In the human wrist are eight small bones called carpals, and arranged in two rows; occasionally between the two rows we have a ninth bone called

the os centrale. This os centrale is always present in the higher apes and some of the rodents. We also find that in every human fœtus, at an early period, a rudiment of this bone exists, but it has entirely disappeared by the fourth month of fœtal life.

Circulatory System.—Every naturalist now admits that the various stages of development of an animal, as well as its specialised parts, are often found to correspond with permanent conditions of animals lower in the scale. A good illustration of this is seen in the development of the human heart and blood-vessels. In the early stages of development we have a heart with a single cavity, connected with a vessel at each end, as in Ascidians; later on the blood-vessels consist of a series of arches which go to the gills or branchial clefts, as in fishes and Amphibia, while the heart consists of two chambers separated by valves, and is placed far forward in the neck. The gill-arches now partly disappear, and, though the circulation still remains single, as in reptiles, the heart-cavities are beginning to be separated into two distinct systems. Soon a double circulation is acquired by a complete separation of the heart into right and left. The right heart propels the venous and the left the arterial blood. At this period the condition is identical with that of birds; at last the true mammalian type of heart and blood-vessels developes, and remains permanent. The arrangement of the great blood-vessels going to and from the heart varies considerably in different mammals. In man the rule is for the great artery, carrying the blood from the heart to the general system, to give off three main branches, named the innominate, left carotid, and left subclavian. These are distributed to the head and the two arms; the main vessel or aorta curves downward, and distributes blood to the trunk and lower extremities. These branches are now known to be derived from certain of the original gill-arches which persist, and when any variation in their arrangement takes place it always occurs in the line of some of these gill-arches; that is, some of the arches persist which usually are obliterated. Nearly all the variations occurring in these large vessels in man are found to be the regular condition in animals lower in the scale; for instance, sometimes only two branches are given off instead of three; each of these, again, dividing into two, one for the head and one for the arm of that side. This is the usual arrangement in the bat, porpoise, and dolphin. The commonest variation of the aortic arch is where the innominate gives off the left

carotid, and so supplies both sides of the head, the artery supplying the left arm coming off as usual. This is the normal condition in apes, bears, dogs, and all the feline tribe. In some rare cases in man one branch only comes off from the aortic arch, and this, again, divides into the various arteries supplying the head and arms. In horses and other solipeds we see this form of aortic arch. Again, the branches may all be given off separately from the arch, as is the arrangement in the walrus.

I have three times met with rather a rare anomaly of the great veins going to the heart from the upper part of the body. The usual arrangement in man, on each side, is for the great vein of one arm and the corresponding side of the head to unite and form a single trunk (brachio-cephalic), so we have two large venous trunks, one on each side; these two trunks then join to form a single large vessel, called the superior vena cava, which empties its blood into the right side of the heart. It occasionally happens that the great venous trunks formed by the veins of the arm and head of each side do not unite to form the superior vena cava, but each continues its downward course and opens separately into the heart. On studying the development of the blood-vessels we find that in early fœtal life this condition of affairs exists, but after a time a transverse branch forms between the two trunks. This branch gradually enlarges, while the left trunk shrivels up, and at birth is only represented by a fibrous cord. This anomaly of the veins we find, then, is a persistence of a usually transient fœtal condition in man, and also that in all birds and many of the lower mammals it is the *permanent* condition.

Muscular System.—The muscular system of man is liable to many variations, nearly all of which are interesting from a morphological point of view.

It is not uncommon to find in man useless rudiments of muscles which exist in a well-developed state in some of our more humble fellow-creatures, and in them serve a definite purpose.

In man the "skin-muscles" are very feebly developed compared with those seen in many of the lower animals. The only remnants of these in man are,—the muscle which wrinkles the forehead (*occipito-frontalis*), the muscle immediately under the skin covering the side of the neck (*platysma myoides*), and the *palmaris brevis*, a little bundle of muscular fibres in the palm of the hand; not unfrequently remnants appear abnormally in other situations, as over the breast, in

the arm-pit, on the back, &c. The skin-muscles are well developed in those of the Mammalia which have loose skins, as, for example, the hedgehog, porcupine, and porpoise. In the hedgehog, when the skin-muscles contract, the animal becomes rolled up as in a bag of muscles. The sportive gambols of a school of porpoises are effected by an abundant supply of these skin-muscles ; in the horse the skin-muscle is called the *panniculus carnosus*, and everyone who has seen a horse twitching its skin to get rid of troublesome flies will easily understand how serviceable it is to that animal.

In all human beings there is a small muscle going from a hooked process (*coracoid*) on the upper end of the shoulder-blade to the inner side of the arm-bone, about the junction of its upper and middle third. Sometimes this muscle is continued down to the lower end of the arm-bone ; or, again, it may be quite short, and attached to the bag of fibrous tissue covering the shoulder-joint. On referring to the anatomy of the lower animals it is found that both these varieties exist normally, but in a much more highly developed state ; they are especially well seen in animals which use their fore-limbs for digging, climbing, or swimming. In them the muscle is of large size, and reaches to the inner edge of the lower extremity of the arm-bone ; in man, when it reaches thus far, it is only rudimentary, and of no use.

Another muscle which I have seen in about 3 per cent of human subjects is a small one which goes from the breast-bone to the upper end of the shoulder-blade. This muscle is well developed in animals which have no collar-bones ; it reaches its highest development in the horse, pig, hippopotamus, and elephant. It is also seen in the Guinea-pig, Norway rat, and wombat. It is quite rudimentary when it exists in man, and serves no useful purpose.

In man, near the elbow-joint, and lying close together, are two muscles going from the upper to the lower arm ; one in front (*brachialis anticus*), which helps to bend the elbow, and the other to the outer side (*supinator longus*), which supinates or twists the fore-arm outward. As a rule these muscles are quite distinct, though they lie side by side ; but in about 1 per cent of cases they are joined together by muscular fibres. This is the normal arrangement in apes and monkeys, the union of these two muscles aiding them greatly in twisting their bodies when hanging by their fore-limbs to the branches of trees. Again, in apes, the muscle forming the posterior fold of the arm-pit is always prolonged down to the prominence on the back of the elbow. In the long-armed apes this muscle is especially well developed, and

serves to swing the whole arm rapidly and powerfully forward—a movement which is of the greatest importance for dexterously grasping remote branches while in the act of climbing. The same prolongation of this muscle is occasionally seen in man, though in a much less developed state, and serves to remind him of the arboreal habits of some of his not very remote ancestors.

In the gorilla, orang, and chimpanzee a muscle, called the elevator of the collar-bone (*levator claviculæ*), is always present: this goes from the upper neck-bone to the collar-bone. It is found in about 3 per cent of human subjects. Other muscles, occasionally found in man in a rudimentary and fragmentary condition, are ones going from the back of the head to the collar-bone or shoulder-blade; they are well developed in many of the Carnivora and Ruminants. I have seen them of large size in the lion, deer, &c.; in those animals they are much used in pulling forward the shoulder.

In about every other human subject is a small muscle going from a bony spur on the front of the haunch-bones to the muscles in the anterior wall of the abdomen. This is the rudiment of the great muscle in the kangaroo, opossum, and other marsupial animals, which supports the pouch where the immature young are carried, and the bony spur is the rudiment of a distinct bone, called the marsupial bone, which always exists in these animals, and gives attachment to the muscles which open and shut the pouch.

In man the short muscle of the foot which bends the toes is attached to the heel-bone, but occasionally the portion going to the fourth and fifth toes is separated from the portion going to the second and third toes, and is attached not to the heel-bone, but to the tendon of the long flexor of the toes. In the gorilla only one slip of this short flexor arises from the long flexor of the toes, but in apes we have as a normal condition the arrangement I have endeavoured to describe as that occasionally seen in man.

The brain of man is distinguished from that of the gorilla and the higher apes by having a greater relative size and being more complex. The different fissures are not so continuous, and are frequently bridged over by brain-matter. In the brains of criminals, the lower races of mankind, and idiots, according to Benedict, the fissures are very confluent in character, and in some the first frontal convolution is divided into two portions, as in apes. In animals lower in the scale than man, the little brain or cerebellum is more or less uncovered by the posterior lobes of the cerebrum or large

brain. This uncovered condition of the cerebellum was well seen in an idiot's brain that I lately had the privilege of examining; the fissures were also of the confluent type; the whole brain only weighed 16 ounces. The internal organs in man, although not subject to great variations, still are sometimes found abnormal. The liver may be divided into a number of lobes, as is seen in the gorilla. This is called a degraded liver. The spleen is often deeply notched and multiple, as in the case in some of the lower animals, and the uterus is occasionally double; an arrangement which is the normal one in the mare, raccoon, rabbit, and other animals. It is double in the human fœtus up to the fourth month, and frequently a trace of this bifid condition is seen in adult life.

I could multiply, *ad infinitum*, the variations in human anatomy which have their corresponding normal condition in the lower animals, but I think I have described a sufficient number of examples to show how common these animal resemblances are in man. On what theory can we account for their existence, except that they are reversions to some pre-existing and lower type? This is the only logical conclusion to which the study of morphology leads us, and "to take any other view," says Darwin, "is to admit that our own structure and that of all the animals around us is a mere snare laid to entrap our judgment."

ANALYSES OF BOOKS.

Can Man affect the Weather, or the Vapour Year. No author's name. Publisher (apparently) McLeod, 67, Port Street, Stirling.

"May it please your Majesty, I doubt the fact." In other words, before falling to work with Mr. Ruskin and with our author to seek out causes, either physical or moral, for the deterioration of the weather, let us be certain that such deterioration really exists. If believers in a change for the worse would only search old records, they would read of vapour years and of cold drizzly summers fully as bad as any which have occurred within the memory of the present generation. Let them, to go no further, read over White's "Natural History of Selborne." Or, if disposed to go a little further afield, let them peruse in "Ciel et Terre" an account of the fogs which prevailed over a great part of Europe during June and July, 1783. On the contrary, what do they say to the year which is now drawing towards its close? Can they find many instances of a milder winter, or of a hotter, drier summer? of more cloudless skies, and of a greater absence of fog? Again, in 1883, which if we mistake not is the author's "vapour year," the east of Europe enjoyed a brilliant and productive summer, whilst in Mauritius and Réunion we learn that the purity of the atmosphere was so complete that the satellites of Jupiter were visible with the naked eye.

Let not our anonymous friend misapprehend us; we are not pleading the cause of smoke. On the contrary, we hate it with a perfect hatred; but we do not wish that it should be wrongfully censured.

Turning to the pamphlet before us we find a very strange proposal. The author appeals to manufacturers to "cease their factories for one week only, and see if such benefits will not accrue in our atmosphere as to lead you to exercise your self-denial for three weeks longer in order to restore our sun to the earth, by which time you will see such effects as will abundantly reward you. . . . You will behold the face of Nature revivifying, you will be released from the burden of the poor!"

The author seems to forget that the owners of factories are not the only consumers of coal and makers of smoke. Probably one-half of our annual yield is burnt by railway companies, steam-ship owners, and by the British householder. Hence a mere stoppage of the mills, as was effected by a mob in the so-called "Holy Month" in 1842 (or 1843?) would be but a very

partial measure of relief. If our anonymous friend could induce the public to substitute German stoves (made of earthenware) for the present open fire-ranges the diminution of smoke would be probably still greater.

It must further be remembered that though the quantity of coal has vastly increased since A.D. 1800, yet as far as factories are concerned, at least, the increase of smoke has not been in the same ratio. There is the Smoke Consumption Act, which in practice effects the combustion and utilisation of a great part of what was formerly dissipated as smoke. The saving thus effected reaches, under careful management, 20 per cent. This Act, we know, applies only to steam-boilers. But the improvements with which the name of Siemens is connected realise also a great decrease of waste in our metallurgical works. Next, too, whilst the volatile products from coke burning were formerly let escape into the atmosphere, they are now more and more generally collected and sent to market.

It may seem a digression, but we cannot help here turning back to one of the benefits to be earned by "ceasing your factories." "You will be released from the burden of the poor." Now whenever a few factories have to stop for a short time, whether from a strike, a lock-out, a scarcity of raw materials (as in the great cotton famine), or a financial crisis, the very first consequence is an increase in the burden of the poor. Local taxation runs up, private benevolence is heavily strained, and shopkeepers are crushed with bad debts. We cannot, surely, conceive that the consequences would be less severe if the stoppage, instead of being confined to a county or two, extended to the entire kingdom, or to the whole civilised world.

As to the author's Physics and Chemistry, they are, we frankly admit, beyond our understanding. As instances we quote the following dicta :—"These doubtless [thunderstorms and heavy rains] were due to masses of smoke-hydrogen which the Sun finding in its way, in striving to get down to the Earth, had then power to ignite by violent shocks and in large masses. This, again, proves how cold is associated with carbonic dioxide; for when first brought down its first effect was to cause very severe winters. Owing to the then hardness of the oxygenised earth, the carbonic dioxide could not penetrate far down, but displayed itself in large masses of snow and ice. . . . The wind-influences, coming in contact with weighty hydrogen masses. . . . We did not then recognise that our enormous quantities of rain were all due to these immense masses of the heaviest [*sic !*] hydrogen. . . . When the hydrogen commences to re-assert its power over the rarefied oxygen of the atmosphere, the nitrogen quits it, and under the Sun's presence, *flies upwards to the Sun itself*." The italics, we remark, are the author's own. A note in continuation of the last sentence adds—"Weighted with a little of this hydrogen. The Sun is attracted by the tiniest

nucleus of matter, and the four parts of nitrogen, each weighted with a little of this hydrogen [*sic !*] are sufficient to attract its rays. On its own surface it receives this hydrogen, and the oxygen ray which attracts it is detained by the nitrogen, enveloped in its fourfold power, and the weight of the oxygen thus shielded brings it down rapidly to the Earth."

For all these startling assertions there is no evidence, analytical or otherwise.

Egypt and the Wonders of the Land of the Pharaohs. By WILLIAM OXLEY. London: Trübner and Co.

THE author begins by saying "It may be thought by the generality of people that there are quite sufficient books published on Egypt." But there is no other country—perhaps no other subject—which admits of being considered from so many sides. Mr. Oxley's own point of view is given in the following words, and it is one, we submit, which cannot be lightly passed over. He writes:—"I came to the conclusion that there was, and is, an affinity between ancient Egypt and modern Great Britain, which had either been unseen or ignored by previous authors. As a psychologist—more acquainted with the occult laws and phenomena pertaining to this science—I saw that without the recognition of this element in ancient Egyptian society more than the half remained unknown; and my chief object in publishing this work is to attract attention to this part of the social, political, and especially religious economy of Egypt, the elements of which, in past centuries, have been so deeply entwined in our own history."

Of course that decreasing portion of the public who are thoroughly satisfied in their own minds that the phenomena included anciently under the head "magical" were simply and purely delusions, will find in this book little to soothe their prejudices.

As a matter of course the Great Pyramid receives here due consideration. Mr. Oxley has no hesitation in assigning to its architect a more than ordinary human foresight and skill. He considers that it embodies in stone "the principles of geography, mathematics, meteorology, and astronomy," and that it further embodies "another and anterior science, the Science of Symbols, implying a knowledge of the *Intellectual evolution and prophetical history of Humanity*." Whilst discussing this subject he rejects as a monstrous fallacy the supposition that law is only applicable to the external phenomena of Nature.

In the account here given of the Great Pyramid we notice a

statement which the astronomy of the present day scarcely verifies :—"Astronomically considered *Alcyone* in Pleiades forms the centre of the astral system, and is the pivot around which our solar system revolves." This idea was suggested about forty years ago, but is now abandoned.

The author, whilst visiting the Pyramid and examining the so-called "Coffer," detected, or had his attention directed to, marks indicating that the stone had been cut by means of a circular saw,—a fact which throws a startling light upon the state of the mechanical arts in ancient Egypt.

It must be remembered that the author is far from accepting the theories of Prof. Piazzi Smyth. He agrees with the view of Mr. G. Massey that the so-called *Hyksos*, or shepherd-kings, were not foreign invaders, but native kings who upheld the ancient cults in opposition to the newer theology of succeeding dynasties.

Mr. Oxley calls our attention to the fact that Egypt was a settled and civilised nation ages before Assyria, Media, Babylon, Greece, and Rome came into being as great powers, and yet she still lives, while all these have passed away for ever. Such persistence must have been profoundly affected by its religious instincts. In Egypt these instincts were manifested in what the author terms a system of Super-naturalism, intertwined not merely with their social and religious, but even with their civil and political life. A belief in the intervention of controlling powers, outside the realm of Nature (?), was to the Egyptians a reality.

We here note that the author takes up a position somewhat strange in our days. He complains repeatedly of "the materialistic tendency which the teachings of modern *savants* are undoubtedly developing."

He admits that since those ancient times to which he has been referring "there has been a great advance in the adaptation of science and art to human requirements as far as mere earthly existence is concerned," yet he adds that "if this is at the expense of the spiritual perceptions and powers of humanity, it becomes a question whether it does not betoken a retrogression.

But we may here ask whether any agency or power can be rightly spoken of as outside the realm of Nature. We must also point out that the author, whilst referring to modern *adaptations* of Science,—many of which we should join him in pronouncing essentially evil,—says nothing concerning recent advances in Science itself.

Another significant passage is the following :—"Strange it is that the majority of our 'scientific' *savants* are so persistently opposed to what they choose to class as Super-naturalism,—meaning thereby the action of any law or power that does not come within the scope of the laboratory, or instruments made

by the hand of man,—as if, forsooth, there could be anything more scientific or irrational than to relegate the action of known natural laws to a blind force." But who limits the scope of the laboratory? What, too, is the author's definition of "law" as distinguished from "force"?

In proof of the real existence of magic the author gives a fearsome incident, which may be found in full in the "Theosophist" for January last.

Any satisfactory discussion of the doctrines thus more or less explicitly put forward would require an extent of space not at our disposal. But we think that whoever wishes to comprehend the recent revival of Occultism, and its possible bearings upon the future development of our race, will derive much benefit from a careful study of Mr. Oxley's book.

We are glad to find that the author utterly scouts the vulgar story of the destruction of the Alexandrian Library. Bishop Cyril and his monks, the murderers of Hypatia, are really the guilty.

On the Amount of the Atmospheric Absorption. By S. P. Langley.

This pamphlet is a communication made to the American National Academy of Sciences, and reprinted from the "American Journal of Science." In it the author calls in question the ordinary value assigned to the absorption of the solar (and stellar) radiations of the Earth's atmosphere. This loss is given by a number of authorities, during the last and the present centuries, at figures differing but little from 20 per cent. So that, if these determinations are correct, supposing the sky be unclouded and the air normally transparent, four-fifths of the light and heat emitted by the Sun reach the Earth's surface at the level of the sea. Without impugning the accuracy of former observers, Mr. Langley shows that the assumption of Bouguer, Herschel, and Bouillet is incorrect, and that the absorption of light and heat by the atmosphere is a far more complicated process than they supposed. Experiment shows that like proportions are not absorbed by like strata, radiant energy being not a single emanation, but the sum of an infinity of diverse ones, each with its own separate rate of absorption.

The author then proceeds to demonstrate that the error occasioned by the ordinary assumption always tells in one direction, lessening the coefficient of absorption. By means of comparative observations made near the sea-level and at altitudes of nearly 15,000 feet he is led to infer that the mean absorption is double the usual estimate, or about 40 per cent.

Journal of the Society of Telegraph Engineers and Electricians. Vol. XIII., No. 53. London: E. and F. N. Spon.

This issue contains a most important paper, by Dr. W. H. Stone, on the "Physiological Bearing of Electricity on Health." The author begins with the admission that the whole question of electricity, as applied to physiological subjects, is in a state of great confusion. He writes:—"While electricity has been making bigger strides than any other physical science, the so-called medical electricity (I abominate the term, for there is no such thing; but I mean electricity as applied to physiology, and therefore to a certain extent to therapeutical pursuits and ends) has marvellously hung back, and it is certainly still in the ante-Faradaic period." One of the reasons which Dr. Stone gives for this backwardness is suggestive:—"The knowledge of physics and the knowledge of physiology is rarely united, and is to a certain extent incongruous, I might even say antagonistic. The mind of the physiologist is not the mind of the physicist, and there is occasionally a little heating from friction between the two." And yet the boundary-line between these two sciences ought to be remarkably fruitful in discoveries!

In proof of public ignorance of the physiological bearings of electricity, Dr. Stone quotes from a recent pamphlet the remarkable utterance that "man is himself a magnet; that his blood and every tissue of his body is pervaded by magnetic influence; that he may be acted upon magnetically by magnets; that in some persons the magnetism disengaged by the contraction of the muscles is sufficient to deflect the needle of the compass, &c."

Another recent author asserts that the resistance of the body varies within wide limits—300 to 100,000 ohms! He adds:—"Suffice it to say that the rheostats are conveniently made of telegraph-wire, well insulated in india-rubber, and the electrodes called so because the human body behaves like an electrolyte in the circuit."

After these specimens of Science for the million, our author expounds the methods in which electric action may prove fatal. There are, firstly, very high tension currents—such as lightning—which kill instantly, as if by concussion of the brain.

In another class of cases there is electrolytic action,—actual decomposition of the animal taking place, of course, at one of the poles. An instance of this kind has come under Dr. Stone's observation.

The third case is thrombosis,—coagulation in the heart, the lungs, or the larger arteries or veins. Here death is not instantaneous. Of this kind was the death at Birmingham where a musician in an orchestra seized hold of two terminals, and

died in about three-quarters of an hour. Similar was the case at Paris, which, though it occurred a couple of years ago, has only been recently reported on.

In explanation of the widely discrepant statements as to the resistance of the human body, Dr. Stone points to the highly insulating character of the human skin when dry, and the consequent difficulty of insuring contact. Some of the methods used, if applied to animals, would be branded and punished as "vivisection." But into the *corpus vile* of man it is legitimate to make holes for the purpose of securing contact.

The resistance of human subjects varies. In a diabetic patient the resistance from foot to foot was 1210 ohms; in a healthy, athletic young man, 930. In paralysis of one side, the resistance on the affected side of the system is generally about 300 ohms less than on the healthy side.

Another interesting fact is that the resistance is decidedly modified by the absorption of metals which takes place in certain trades. In a coppersmith the author found a difference of nearly 300 ohms between the hand with which he held the hammer—which was impregnated with copper—and the other hand. Mercury lessens the resistance very distinctly.

Contrary to what is often asserted, the nerves are remarkably bad conductors; muscles are much better; and water, serous fluids, and saline solutions better still. Thus when dropsy ensues the resistance goes down to one-half.

Dr. Stone does not accept the statements made of the influence of magnets on the animal body. "He had tried the experiment on a large scale, and it was now being repeated by a Society in his laboratory [the Society for Psychical Research ?], but excepting the imagined sight of flames by some hysterical girls nobody had been able to point to any effect whatever produced by magnets."

Longman's Magazine. No. 24, October, 1884. London: Longmans and Co.

There is little, very little, in this issue which can at all come within our notice.

"Norway once More," by J. A. Froude, is a curious production. He finds "bilberries as large as grapes!" But literary characters, historians, and politicians are not trained observers, and we must allow them some latitude.

"Abjectness" is a curious subject to write about in an age one of whose characteristics is gratuitous insolence.

"Sea-Sand Grass as a Land-Winner," by F. A. Paley, is a

capital study of one of those humble agencies by which Nature effects wonderful results. That a coarse insignificant grass should bind together thousands of tons of shifting sands, so that they can neither drift back into the sea nor spread inland over the cultivated country, is a fact almost as curious as that earth-worms should manufacture arable soils and bury erratic boulders.

The Medium and Daybreak. A Weekly Journal devoted to the History, Phenomena, Philosophy, and Teachings of Spiritualism.

THIS paper has been sent us with a mark to an account of Miss Dale Owen's visit to Scotland, and especially to New Lanark, the scene of her grandfather's activity. The dictum of Robert Owen, "Man the creature of circumstances," is quoted. But we fear—or rather we know—that both this social reformer and his opponents overlooked the great truth that the preponderating circumstances are pre-natal; or, as it has been ably expressed elsewhere, "Nature counts for more than does nurture."

We regret to find a letter consisting of an outbreak of party politics, not originally addressed to the Editor of the "Medium and Daybreak," but copied, it would seem, from an Edinburgh contemporary. Surely the position of the philosopher, like that of the true poet, should be high, very high,—"above the battlements of party."

A writer who signs himself M., and who is said to be of the Hebrew nationality, thinks that "none should ever attempt to philosophise henceforth outside the dominions of pure physics, and social and political questions, without becoming convinced of the truth or otherwise of Spiritualism."

Light. A Journal of Psychical, Occult, and Mystical Research. Vol. IV., No. 197.

IN this issue we find some matter which may fairly claim attention. An exceedingly able writer, "M.A. (Oxon)" discusses a memoir on "Visual Hallucinations in Hypnotism," communicated to the "Revue Philosophique" by M. Alfred Binet. Observations were made upon five hysterical girls at the Salpetrière. It was found that if the patient has one eye colour-blind, coloured

hallucinations cannot be suggested to it. One subject always saw at her *left* side a man dressed in scarlet: when this patient's *right* eye was closed, and her *left* eye—which was colour-blind—alone remained open, the man in question appeared to her grey and enfolded in clouds. A prism placed before the more normal eye of a colour-blind person doubles the hallucinatory image, and makes one of the images undergo a deviation in conformity with the laws of optics. A spyglass removes or approximates the object precisely as if it were real. But the strangest fact is that some—not all—of the hallucinations respond to Sir D. Brewster's test. It is well known that if we look at any object placed before us, and at the same time apply mechanical pressure to the eyeball, the object appears doubled. This method has been proposed as a means of discovering whether anything seen has an objective reality; but according to M. Binet's results it appears untrustworthy. "M.A. (Oxon)" suggests that the patients should be got to look at their hallucinatory images through a double-refracting medium, and raises the question—Is thought a substance?

The same writer gives some interesting specimens of the alleged prophecies of the "Seer of Brahan," Coinneach Ore, who flourished about the time of the Great Rebellion. Several of these prophecies are described as having been fulfilled long afterwards, in the minutest details. The difficulty lies, of course, in ascertaining whether these prophecies were really uttered as alleged, or whether they have not been made to fit the events.

The National Reformer, Radical Advocate, and Freethought Journal. Vol. XLIV., No. 16.

THERE is very little in this paper upon which we have the right or the competence to sit in judgment, and either approve or disapprove. We note, however, the record of a fact, curious, but by no means unexampled. One Mr. Holmes writes that in his boyhood he witnessed a successful instance of the "Scare Cure":

"A gentleman who had suffered for months from rheumatism in an aggravated form, and who was evidently unable to use his limbs, was one day placed in a reclining chair, supported by blankets and pillows, and was wheeled through two or three large rooms to one in which a large open fire was burning. Over this fire a kettle with two or three pails of water had been placed for heating. Suddenly the kettle was upset, and the water pouring into the active fire caused a cloud of steam and ashes to fill the room. Our invalid leaped from his chair, and made good time to his bed-room. In about ten minutes he arose and dressed,

declaring that he felt no pain, and in a few days he was about his regular business. I knew him intimately for ten years later, and he continued strong and healthy, a firm believer in the *scare* cure." It may well be asked if this case is not as good as any of those recorded concerning the "faith cure"?

Annual Report of the Board of Regents of the Smithsonian Institution. Showing the Operations, Expenditures, and Condition of the Institution for the Year 1882. Washington: Government Printing Office.

It is satisfactory to learn that the premises set apart for the National Museum, capacious as they are, are being overtaken by the growing collections, and that further accommodation will be imperatively required. Several tons of specimens accumulated by the United States' Geological Survey are as yet but partially available, for want of space.

Among the explorations now being carried on more or less exclusively under the auspices of the Smithsonian Institution may be mentioned those in Greenland, Labrador, the Arctic Ocean, Alaska, St. Michael's, Florida, &c.

The Reports on Progress in different Sciences have, of course, the disadvantage of coming down no later than the year 1882. Besides this, some of them consist chiefly of references to journals, transactions, or to special independent works.

Meteorology and Anthropology appear to be the most favoured subjects.

Under Anthropometry we notice Zoja's scheme for a more precise classification of human stature. Here, under the not inappropriate head, "Vulgar Terms," we find the tallest and the shortest men described as of "phenomenal" stature. We regret to find this most unphilosophic term creeping more and more into use among men who certainly should know better, and in cases where "abnormal" or "enormal" would be a more correct expression.

The Mason College Magazine. Vol. II., Nos. 3 and 4.

This magazine has, like many of its contemporaries, instituted a "London letter," the writer of which, Mr. W. Greatheed, says some things which well deserved saying. He "can't go to press

without saying a word on the British Museum." But he has nothing to say concerning that momentous change which has made the Museum practically inaccessible to many of its former students.

At a meeting of the Mason College Union the question of cremation was brought forward, and a motion in its favour was carried by a majority of thirty-two to ten. The arguments against cremation were not remarkable for either novelty or cogency. One speaker seemed to lay weight on the circumstance that a Parliamentary majority of nearly two to one had recently declared itself against cremation,—as if Parliaments were localities favourable to any movement in the right direction! Professor Sonnenschein suggested burial in light wicker baskets, probably forgetting that the waste of land in the outskirts of our cities would thus be perpetuated, and that, though decay would be accelerated, disease-microbia would find every opportunity for free dissemination.

"Student-Life in Paris" is an able article, in which the black spot of French higher education—the dominating bureaucratic influence—is strangely overlooked.

In a debate on the proposition that "Where ignorance is bliss 't is folly to be wise," Miss Cohen contended that "sorrow is a moral force, and should be utilised, not shunned." Considering that sorrow is physically debilitating, and that it interferes with the cultivation of the intellect, it should be considered whether some of the teachings of the present century are anything more than attempts to bring their author's previous opinions into apparent harmony with the principles of Evolution.

Papers on the Pollution of the Clyde at Glasgow, with Plans for the Collection and Treatment of the Sewage by Precipitation. By G. W. Muir. Glasgow: W. Porteous and Co.

The near approach of the cholera, and the possibility that in the next season it may do something more than approach, have revived the fading interest in sanitary reform. Some sense and probably more nonsense have been talked on the subject; the impracticable notions of the late Royal Rivers' Pollution Commission have been once more raked out of the dust-bin of the past, where it seems not to have become entirely purged from that lack of truthfulness by which it was characterised a dozen years ago.

Among other communities the good city of Glasgow became conscious that it, too, has a very unsavoury—though once

beautiful—river, and that, unlike London, it does not possess the right to go on polluting.

The compilation before us contains little with which students of the sewage question are not already familiar. But old truths have to be again and again repeated, especially when they are almost drowned by old errors. We can therefore recommend this pamphlet to all friends of sanitary reform.

The American Exhibition, London, 1886. *Public Opinion in Great Britain and the United States.* London: Waterlow and Sons, Limited.

The American Exhibition of the Arts, Manufactures, Products, and Resources of the United States of America, London, 1886. London: Waterlow and Sons.

As the subject-matter of these pamphlets is discussed by our esteemed contributor "An Old Technologist," they will require no further notice on our part.

CORRESPONDENCE.

*** The Editor does not hold himself responsible for statements of facts or opinions expressed in Correspondence, or in Articles bearing the signature of their respective authors.

HYLOZOISM AND HYLO-IDEALISM.

As a further contribution to my argument, in the October issue of the "Journal of Science," that each individual sentient creature frames its own universe, or, as the great Naturalist Oken puts it in his Pythagorean fragment, that the Universe is only a continuation of our sense organs (Sinnen system)*, let me be permitted to quote the following numbered Notes. They are extracts from the "Conclusion" of an otherwise vulgarly realistic treatise, "Water and its Teachings in Chemistry, Physics, and Physiography," by C. Lloyd Morgan, F.G.S., and seem thoroughly to vindicate and sanction, even as the result of Physical Research quite innocent of Biology, that hylo-phenomenal system of the world and of Life and Mind I have been presenting to the notice of my contemporaries for very many years past. This somatic theory seems quite to march with the Pre-Socratic Protagorean Hylism that each man is to himself the measure and standard of all existing things or nothings whatsoever—a thesis which, by negativing all knowledge outside the Self, in a world where all is seeming, seems quite to dispose of, and depose the immaterial or supernatural (animistic) chimera at the root of all Theology and Divine Worship (Religion). The whole spiritual domain is clearly thus, at one fell swoop, for good and all, for ever and a day, eradicated by identification of thought and its objects (processes)—"things," on this hylo-phenomenal assumption, being resolved, or dissolved, into thoughts, *i.e.* cerebral processes. I intercalate among Mr. Morgan's notes a few comments of my own.

Note 1712.—Water is coloured. Now, one of the conditions of this colour is that there should be an eye to see it. [This condition is the very essence of sight which an object seen really is].† Physically speaking, the water is not coloured.

Note 1713.—The water may be warm, but this warmth must be *felt* [or, in other words, heat is ultimately a mode of feeling, not merely a mode of motion, as Dr. Tyndall, sticking half way, as vulgar realism must, has described it]. Physically speaking,

* I need hardly point out to the readers of the "Journal of Science" that the German word *Sinn* means mind as well as sense. *Sinnen welt* is the usual term for external world, the term "external" being thus clearly a misnomer, all sense and thought being self-evidently subjective or "internal."

† Elsewhere the eye has been termed "the only colour box," a synonym or parallellism for the sole manufactory of light.

it is merely in vibration, and this vibration must be communicated to our nerves [*i.e.* be subjectived or assessed] before it is felt [cognized] as warmth.

Note 1714.—All our knowledge of water [and of every "thing" else] is derived through our senses of sight, touch, hearing, smelling, and taste [and which senses sensate only sensations; they cannot sensate "things" *per se.*]

Note 1715. When water in any way *affects* these senses it gives rise to states of consciousness, which are not material like the water [which we can thus only "know" as a "state of consciousness."] Water, and *pari passu*, all other *pseudo* objects or *tout ensemble* of such are therefore only mental (cerebral) *affections*, or symbols, the German equivalent for which latter term is *Sinn bild* (sense image).

Note 1716.—These immaterial [ideal or phenomenal] states of consciousness are symbols for that material we call water [and the converse is equally true that water is a symbol or sense image conjured up by the magic of our own sensorium.]

Note 1717.—All our knowledge, then, is a knowledge of those symbols. [Surely all *Gnosis* of any kind must be subjective or egoistic.] But since these symbols are the same [an ambiguous term; they can only be similar, *not identical*, in any two heads] for you and me, we can refer them to an outside entity we call [or visualize, or represent to ourselves] as the water. [The *sense* of "outness," just because it is a sense, or sensation, or idea, *must*, therefore, be a strictly inner function.]

Note 1718.—One of the conditions of all that we know about water [the essence rather of all our *Gnosis* altogether, abstract or concrete], is that there should be someone constituted like ourself to experience the states of consciousness, [which states are all the *Gnosis* to which we have access of all things visible or invisible within or without us].

Note 1719.—In other words, all that has been said in these notes applies to water as it appears to you and me [*i.e.* as a hylo-phenomenon]. And thus ends Mr. Morgan's treatise. Of course it is self-evident that any other *pseudo* object or sum total of them answers to the above stipulations as well as water. Indeed, Mr. Morgan elsewhere, in the body of his work, while treating his theme quite in the spirit of vulgar realism, defines a so-called "Law of Nature," universal gravitation being specially indicated (see Note 744, &c.), as simply "a generalised statement of facts as we know them," *i.e.*, as an abstract mental process or idea. This definition is amply confirmatory of Hylo-Idealism (Mentalism), *i.e.*, the unification of subject and object, thus degrading the latter to the parasitic rank of *pseudo* object. We thus practically deify Humanity, and indeed all other living creatures endowed with consciousness, as creators of their own world.

ROBERT LEWINS, M.D.

October 8, 1884.

NOTES.

A NEW Camera Lucida has been invented by Dr. Schröder, possessing many advantages over the well-known contrivance of Dr. Wollaston. The pencil emerging from the eye-piece of the microscope is reflected twice, as in the old instrument, but the view of the paper and pencil is obtained by means of another prism placed under the first; the pencil from the microscope is totally reflected, and cannot pass through the film of air between the prisms, and the paper is seen directly through the two prisms, which offer no more obstruction to the view than a thick piece of plate glass. The position of the image does not shift when the eye is moved, and the painful strain caused by the bisection of the pupil in the Wollaston instrument is entirely avoided. Drawings can be taken either with the body of the microscope at the usual inclination of 45°, or in a vertical position, both more comfortable in every respect than the old horizontal one, and preventing disturbance of the illuminating arrangement by having to shift everything when a drawing is required.

M. Miquel (Semaine Médicale) has examined the number of bacteria in portions of air of 10 cubic metres each, taken in quick succession. At heights of 2000 to 4000 metres in the Alps the number was 0; on lake Thun (560 metres above sea-level), 8; near the Hotel Bellerne (500 metres), 21; in a room in the Hotel, 600; in the Parc de Montsouris, 7,600; and in the Rue de Rivoli, Paris, 55,000. Cold has little effect upon bacteria. Miquel found 750,000 living bacteria in a block of ice from Lac de Joux which had been preserved for eleven months. Atmospheric microbia resisted thirty-six hours' exposure to a temperature of $-100°$ C., and revived in three days.

Higher Education in China,—Perhaps the most efficient obstacle of all, not only to mining, but to every other form of the economic application of science, lies in the essentially anti-scientific character of Chinese education. Official employment is the sole and the universal ambition of the Chinese people, and the only avenue to it is through competitive literary examinations. This is no sham, the examinations being so severe that only a minority of the candidates pass, the plucked ones coming up year after year, even to old age. The subjects of examination are handwriting and style. The former is so much prized by the Chinese, that busy men practise it all their

lives, and mottoes and texts written by eminent hands are eagerly sought after. A good literary degree in China implies a marvellous amount of study of the Chinese classics, which, to secure the highest excellence, have virtually to be committed to memory. The competitive essays on given themes are judged, not by their substance, but by their style, that is to say, by the writer's ingenuity in filling his paper with laconic but recondite classical allusions which would be unintelligible to a reader not conversant with the whole range of Chinese literature. This system makes such exhaustive demands, not only on all the best years but all the half-hours of life, as to leave absolutely no room for natural science, even if the taste for it existed. It follows, as a natural consequence, that a Chinese literate is more ignorant than a European child of everything in earth, air, and sea.—"Mining World."

[May we English not almost say to ourselves, "*Mutato nomine de te Fabula narratur.*"

At the Blois meeting of the French Association for the Advancement of Science Dr. Voisin described his successful experience in the hypnotic treatment of lunatics and sluggards. If he could hypnotise certain mischievously-active persons, and reduce them to a state of harmless idleness, he would deserve thanks.

We read that "the electric light is a great boon to fruit growers near the cities in California. At Los Angelos, it is reported, several bushels of moths are killed every night, while at Sacramento it is believed that the black beetle has been nearly exterminated." But what if species useful in the fecundation of plants are killed off also?

The quantity of solid excrementitious and refuse matters at Paris is 2,500 cubic metres daily. The volume of the sewage is 300,000 cubic metres per twenty-four hours.

Dr. Ogston, of Aberdeen, describes, in the "British Medical Journal," a decided and fatal case of scarlet fever in a canary.

We share the regret expressed by our medical contemporaries at the hesitation—to use the mildest term—shown by Mr. Mundella in suppressing the ruinous system of overwork in elementary schools.

The walnut tree may be most advantageously felled for timber at the age of 250 to 300 years; the Spanish chestnut at 200; the lime-tree at 125; the beech at 95; the fir at 90; the white willow at 40; and the alder, the birch, and the poplar at 50 to 60 years.

An abnormal specimen of a species of the genus Homalomya, having seven legs, was exhibited by Mr. Billups at the October meeting of the Entomological Society.

The connection between the hay Bacilli and those of anthrax (*Bacillus subtilis* and *B. anthracis*) is the subject of controversy. Buchner maintains their identity, which Koch denies. Prazmowski pronounces them specifically distinct; but he agrees with Buchner and Pasteur that a non-pathogenous race may be obtained from *B. anthracis*, though retaining all its original morphological characters.

S. G. Potter, D.D., winds up an attack on Spiritualism with a very neat advertisement of Carpenter's "Mental Physiology."

The French Association for the Advancement of Science is so largely technological that it might fitly take the title of an "Association for the Advancement of Industrial Art."

It appears ("Ciel et Terre") that in France fragments of a tree which has been struck by lightning are eagerly collected and carefully preserved by the country people as a cure for toothache.

According to M. Kremser, who has recently studied the rainfall of Italy, Germany, and England, we have had in this country, from 1845 to 1880, nineteen years too dry and seventeen too wet.

"Cosmos les Mondes" concludes that in the experiments of Mr. Capper, as in those of Mr. "Stuart Cumberland," there is nothing marvellous beyond excessive sensibility combined with great skill in observation.

Certain astronomers ("Ciel et Terre"), especially Von Lindenau, and more recently Dr. J. Hilfiker, of Neuchatel, maintain that there is a periodic variation in the apparent diameter of the sun. Dr. Hilfiker holds that this periodicity coincides with that of the sun-spots. The maximum diameter coincides with the sun-spot minimum, and *vice versâ.*

M. Alphonse de Candolle has discussed, before the Natural History Society of Geneva, the question whether the colour of the human eye is hereditary. He maintains that dark eyes tend to become more numerous. Most frequently the colour of the mother's eyes determines that of the childrens', and especially of the sons'.

At the Blois meeting of the French Association M. E. Cartailhac proved that the operation of trepanning was known and practised in prehistoric ages.

Otto Krimmel ("Meteorol. Zeitschrift") states that at Kiel, on the evening of July 2nd last, drops of rain fell so large as to make spots on the flags of 6 to 8 centimetres ($2\frac{1}{3}$ to 3 inches) in diameter.

The "Graphic" thinks that for one person who feels any interest in the proceedings of the British Association a hundred will carefully read over the reports of the late "Church Congress." This is an unadvised utterance. The proceedings of the British Association will be carefully summarised and criticised in Germany, Italy, Belgium, France, &c., when no one outside of strictly clerical circles will even think of the Church Congress.

According to Mr. J. B. Haycraft ("Proc. Royal Soc.") leeches, in biting, inject into the blood a liquid which destroys the natural coagulative power of the blood.

Prof. E. D. Cope read an exceedingly interesting memoir on Catagenesis before the Biological Section of the American Association.

"Science" protests emphatically against the manner in which the law allowing American colleges the right to import foreign scientific periodicals duty free is nullified by the Customs officials.

The crayfish (*Astacus fluviatilis*) is becoming scarce in France, owing to an epidemic occasioned by a parasitic fungus, *Mycosis astacina.*

Mr. W. Brewster ("Proceedings of the Boston Natural History Society") mentions the curious fact that the kittiwake drinks salt water readily, but cannot be induced to taste fresh water.

At a late conference of homœopathists the President stated that his fraternity "raise no objection to the germ theory," but assert "that it affords no help whatever in the cure of disease!"

In the "American Naturalist" we find the following exaggerated dictum:—"Mr. Romanes, like most of his countrymen, is a devout and blind follower of Darwin, and, like most disciples, carries out his special theory of Natural Selection with more of dogmatism and unwavering trust than his master."

According to French contemporaries the phrenologists, physiognomists, and graphiologists are confronted by a new body of rivals, the pilographists, who profess to judge a man's character by his beard.

The necessity for eliminating the "Economical Section" of the British Association was never so fully manifested as at the late Montreal meeting.

The Section of "Mechanical Science," too, was guilty of something very like a trespass into political regions. Such

escapades, though committed by men of eminence, cannot be too profoundly regretted or too emphatically denounced.

French writers express dissatisfaction with the Presidential Address of Professor Lord Rayleigh, as not doing justice to French physicists.

The proposed International Association for the Advancement of Science has our most earnest good wishes, provided only it will eschew politics, which would there be more fatal than in a national association.

M. Vial, writing in "Les Mondes," seems desirous of conjuring up the old ghost "caloric," which we hoped had been laid for ever.

M. Bouquet de la Grye connects the inroads of the sea in the thirteenth century with the elevated temperature then prevailing, which permitted the cultivation of the vine in England. He suggests that the ice in the polar regions melted and increased the volume of the ocean.

Dr. Hans Molisch has demonstrated that the roots of plants may be deflected from their normal direction by exposure on one side to certain gases. If such gases are in moderate quantities the roots bend away from their source (negative ærotropism); if in larger qnantities towards such source (positive ærotropism). The side of the root most exposed to the action of the gas grows more strongly than the other.

It is said that Dr. Klein, who is studying the cholera question at Calcutta, is satisfied that Dr. Koch's bacillus is not the cause of the disease, and has swallowed a number of these microbia without any evil results.

M. de Cherville ("Cosmos les Mondes") records an instance of friendship between a tame magpie and a pack of fifteen dogs.

Five bursaries have been founded at the University of St. Petersburg in honour of Charles Darwin. They are to be employed for the support of five students in the five chief branches of Natural Science.

Dr. T. More Madden points out that the evils springing from the abuse of alcoholism were never so prevalent as at present, and that they are now traceable in the diseases of youth as well as in those of mature age.

In some districts it is believed that the wood of a tree which has been struck by lightning will not burn; that truffles are generated by thunder; that the bodies of those killed by lightning do not putrefy (the very opposite opinion exists also); and that men are never struck by lightning when asleep.

We lately witnessed a curious instance of intelligence on the part of a young cat. She prefers water to milk, and has repeatedly seen it drawn from a tap for her use. On the occasion in question she sprang up and repeatedly patted the handle of the tap with her paws, looking from time to time if the water had begun to flow.

The mortality among the workmen employed in cutting the Panama Canal has fallen to twenty-five per thousand.

The staff of the British Geological Survey now consists of one director-general, three directors, three district surveyors, fourteen geologists, twenty-five assistant geologists, four naturalists and palæontologists, four fossil collectors, and three general assistants.

According to Herr Pechule, of the Copenhagen Observatory, the number of red stars in the southern hemisphere is considerable, increasing as we approach the milky way.

At the Montreal meeting of the British Association, Professor Dawkins urged the opinion that the Eskimos are survivors of the pre-historic race known as "Cave-men."

The proposed baby-show, in France, has been officially interdicted on the grounds that its character was not distinctly scientific, and that the collection of such a great number of babies might give scope for infection.

Mr. T. Mellard Reade ("Geological Magazine") contends that if the island of South Georgia had a former land-connection with South America at the distance of 1200 miles, this fact is a proof of the want of permanence of oceanic areas.

M. S. Féron ("Cosmos les Mondes") gives an instance of a hairbreadth escape from premature interment in cholera, and suggests that in this disease burial during apparent death may not be uncommon. On the faith of extensive experience in India (Pondicherry) he denies the contagious nature of cholera.

According to Mr. F. Cushing (British Association) the civilisation of the Zunis of New Mexico must have been purely indigenous. Its successive stages can be very distinctly traced.

According to the municipal engineer of Toulon, butchers and bakers were most liable to cholera, whilst the scavengers entirely escaped.

Concerning the height of the atmosphere observers differ; the lowest estimate (that of Biot) being 48 kilometres, and the highest (that of Liais and Ritter) 350 kilometres.

Dragonflies have been uncommonly numerous in various parts of the Continent during the summer. They will doubtless have cleared the air of gnats and Aphides in the winged state.

According to " Science " a lady has offered the University of Heidelberg a donation of £5000 to admit female students to the lectures. The Senate declined this handsome *trink-geld.*

According to Sir G. Birdwood the re-planting of North-western India already makes itself beneficially felt in the increasing rainfall in the Southern Punjaub, Southern Afghanistan, Northern Beloochistan, and Northern Scinde.

A block of pumice has been picked up by a French vessel, and solemnly presented to the Academy of Sciences by M. A. Milne-Edwards on the possibility that it may have been derived from the eruption of Krakatoa !

The German Association at its last meeting showed a tendency to indulge in foreign politics.

M. H. Beauregard has had an opportunity of studying the first larval form of *Epicauta verticalis.*

Mr. James Startin, M.R.C.S.—We are exceedingly sorry that we overlooked your important exhibit showing the ill effects of goods dyed with poisonous colours. Our sympathies are entirely with you in this matter.

TWENTY-FIRST YEAR OF PUBLICATION.

THE JOURNAL OF SCIENCE,

AND ANNALS OF

ASTRONOMY, BIOLOGY, GEOLOGY, INDUSTRIAL ARTS, MANUFACTURES, AND TECHNOLOGY.

MONTHLY, FORMERLY "THE QUARTERLY JOURNAL OF SCIENCE."

Vol. VI. (Third Series)
No. CXXXII.

DECEMBER 1884.

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LONDON:
3, HORSE-SHOE COURT, LUDGATE HILL,
Where Communications for the Editor and Books for Review may be addressed.

PRICE ONE SHILLING AND SIXPENCE.

THE

JOURNAL OF SCIENCE.

DECEMBER, 1884.

I. HYLO-IDEALISM: A DEFENCE.

(Communicated by ROBERT LEWINS, M.D.)

> "Now call this One [essence] what you will, the result is the same, speculatively or practically. There may be certain degrading associations attached to the idea of substance, and certain exalted associations attached to that of spirit. But what difference can our associations make with respect to the real nature of things?"—LEWES'S *History of Philosophy*.

THE ingenious writer who has lately impeached Hylo-Idealism in the pages of this "Journal" places me in one respect at a disadvantage. He uses weapons which are not in my armoury, and which I have never been trained to wield. Freely confessing my inability to answer Mr. Billing in his own style, I shall proceed on the assumption that he is the most courteous and chivalrous of antagonists.

And, first, I must express the pleasure with which I find that, spite of all superficial differences, Mr. Billing and myself are really in perfect accord. The sentence which heads this article, and which he quotes from Lewes with apparent approval, is a complete answer to all insinuations respecting the "degrading" nature of Materialistic Monism. Elsewhere my seeming opponent virtually avows himself a Hylo-Idealist, remarking, with admirable clearness and force, that "the external world is as much a part of man as his own egoism." If the creed which I advance, "the fundamental principle of which is the Self," be really "subversive of all morals and order," and likely to make "the most disgusting license the rule and practice," surely Mr. Billing must consent to share the blame.

After this I need not seriously controvert any of the arguments brought forward, more especially as their premises are chiefly of the "intuitive" order, and as their logical sequence and the language in which they are couched are sometimes not very comprehensible to an ordinary intellect. Mr. Billing, however, represents some of them as "the commonest of surface reasoning," and I will not cavil at this description, which, perhaps, is not so completely irreconcilable with my own impression as may at first sight appear.

Having thus happily agreed with my adversary, I proceed to set forth in some detail a side of the Hylo-Idealist position which has scarcely received the attention it deserves. Such misconceptions as that of F. P. L., in your July number, are very natural, occur frequently, and therefore deserve to be carefully noticed and corrected. Mr. Billing falls into a similar mistake in his remarks on the oft-quoted saying that "Man is the measure of all things"; also when he alleges "analytical dissection, observation, and experiment," which "render Science possible"; also the facts of "geology and astronomy" as disproving Hylo-Idealism.

The difficulty is briefly as follows:—If "things" are "thinks," how can they be realities as well? If matter is ideal, how can ideas be the products of a material brain? I hope in the course of this article to dispel the perplexity, which really arises from an ambiguity in the use of the words "matter" and "things." I must begin by very briefly indicating the position and basis of Universal Scepticism.

Berkeley (by no means a Universal Sceptic!) argued that we have no right to attribute to the objects about us any existence independent of the mind. We ought not to assume that they are anything more than groups of our own sensations. Matter is a mere fiction. Byron writes in "Don Juan":—

> "When Bishop Berkeley said there was no matter,
> And proved it, 't was no matter what he said."

But we cannot treat the subject quite so lightly. Of course Berkeley *proved* no such thing; he proved only the insufficiency of the ordinary grounds for asserting that there is a reality underlying material phenomena.

Hume went a step farther. He showed that if we have no reason for believing in the existence of matter as distinct from material phenomena, neither have we any reason for believing in the existence of mind (or "spirit") as distinct from mental phenomena. He saw in the mind simply

a chain of feelings, or, as he calls them, of impressions and ideas, the latter being "copies" of the former. We shall see later that this word "copies" contains in itself the refutation of Universal Scepticism. But the Ego, considered as an Entity which manifests itself in "impressions and ideas," and links them into an organic whole, was to Hume as pure a fiction as Matter was to Berkeley.

It is not necessary that we should proceed beyond Hume. None of the great German philosophers has really turned his position, and if we desire to ground ourselves thoroughly we must return to Hume, and face his problem.

First, it must be admitted that Hume is quite right in considering the existence of the Ego as a pure assumption; but it can be shown that philosophy without assumptions is unthinkable. I do not, however, invite my readers to assume anything so debateable as the Ego. I ask them to assume only what the sceptic himself tacitly assumes when he begins to reason, and that is the *possibility of reasoning*. As I have elsewhere remarked, to reason in defence of reason is to beg the question,—to reason against reason is to commit suicide.*

Let us see what our assumption involves. It involves the belief that our ideas have some relation to objects, and our concepts to ideas;† the belief, that is, that it is possible to *remember*, and to *think*.

But *what* is the relationship which we have thus asserted? When we call to mind the concept, say, of a pin, we know that this concept is derived from various mental images of pins which we have formed from time to time. We know that these mental images were actual re-presentations of certain objects or grouping sensations, including hardness, brightness, slenderness, sharpness. Conversely, facts about pins not yet seen may be deduced from the concept,—as that they will prick, and will bend if subjected

* St. Augustine says "Everyone who knows that he doubts, knows something that is true, and is certain of what he knows. . . . . Therefore no one who can doubt at all ought to doubt that there is such a thing as Truth." Again, he says, "Men have doubted whether the vital force is of air, or of fire; but who doubts that he himself lives and remembers, and understands and wills, and thinks and knows and judges? Seeing that even if he doubts, he lives; if he doubts, he remembers why he doubts; if he doubts, he understands that he doubts; if he doubts, he wishes to be certain; if he doubts, he thinks; if he doubts, he knows that he is ignorant; if he doubts, he judges that he should not venture to assert."

† I use the term "idea" in the sense of a mental image of a sensation, an object, or a relationship; the term "concept" in the sense of a generalised idea, formed by the juxtaposition of two or more mental images, the rejection of the points in which they differ, and the retention of those which they have in common.

to sufficient pressure. Here we have a simple case of inductive and deductive reasoning.

We are also sure that the concept could not precede the idea, nor the idea the object. If it could be so, we should be able to remember things before they happened, and to reason about them before we remembered them. The future would be chronicled like the past.

The object, then, is not an accidental, but a *necessary*, antecedent of the idea and the concept. And this is equivalent to the assertion that the successive members of a chain of reasoning do not merely *succeed*, but also *influence* each other. They are not a mere series of dissolving views, which can be arranged in any order. There is an actual *genetic connexion** between them. But in this case they must be something more than passive pictures ; for genesis implies action.

What, then, are we to say about feelings, states of consciousness, or (to employ a useful term) psychoses, since they are not to be spoken of as "passive pictures" ? Evidently we must say that there is more in them than the mere appearance ; because an appearance, *quâ* appearance, can only be passive : therefore we are forced to the conclusion that they are manifestations of some active Entity, some "*Ding-an-sich,*" which shows itself in each member, and unites the whole together in a definite manner. I say Entity, rather than entities, because the *plexus* of psychoses called the mind forms in a very intelligible sense a unity, though the conception of unity is of course always relative, and there is no possible unity which may not, under some light, be considered as a multiplicity. The sentient and thinking "Thing-in-itself" (*noumenon*), at which we have at last arrived, may be termed the Ego.

Leaving this part of our subject for the present, let us turn to consider the relation between the Ego and its environment,—if, indeed, it *have* any environment. Having faced Hume's problem, let us next face Berkeley's.

We find that the sphere of consciousness may be roughly divided into two parts, which may provisionally (though inaccurately) be called the *inner* and the *outer*.

The inner includes mental and physical pains and pleasures, desires, volitions, ideas, and concepts. All these I shall group under the name of *feelings*. The outer is composed of objects and their perceived relationship. This outer region I may call the realm of phenomena.

* I use the term "genetic" in preference to the term "causal," as less suggestive of obsolete ideas.

Having established the existence of the Ego, we now proceed to ask whether there is anything besides the Ego? Is the world simply the product of the individual mind? Are objects mere mental phantasms, or are they manifestations of active entities which co-operate with the Ego? To answer this question we must separate them into three classes.

The majority of the objects which we perceive have no direct and constant relation to our mental and physical pains and pleasures, and do not obey our volitions. Neither do they seem to have any feelings of their own. Such are stones, gases, plants. These appear to act and react upon each other: I say *appear*, because I do not wish to assume at present that there is any reality corresponding to this appearance, or that a rock or a tree is anything more than a group of phenomena. If we investigate more closely, we notice that every action is followed by a reaction, and that the reaction always bears definite quantitative relation to the action. We noticed nothing of the kind when dealing with ideas and concepts, because neither an idea nor a concept admits of quantitative measurement.

But these apparent actions and reactions among objects are not necessarily accompanied by any feeling in the percipient, beyond the visual and mental one of perceiving them; that is, when you see one stone strike against another you do not feel hurt, unless your finger or some other part of your body be in the way.

But this brings us to the second class of objects, which consists, for each individual, of one member, or rather of a complexus of members. When any part of this complexus is touched, he feels; when one part of it touches another, he can distinguish two sensations. When it is injured, he is hurt; and its movements correspond with his volitions. This he names his *body*.

Let us enquire what he notes with regard to it. This plexus of *phenomena*, called body, is closely connected with a plexus of *feelings*, called mind. Take a very simple example showing this connexion—the prick of a pin. A bright, sharp, smooth, hard object, of a certain size and shape, is perceived by sight and feeling in a definite position with regard to that group of phenomena known as the finger. The skin is punctured; blood flows. A sharp pain is felt, and the hand is snatched away. But this is not the end of the matter. Several ideas have been generated,—the mental image of the pin, of the prick, of the blood, of the pain, and of the consequent movement; and these are henceforth

inseparably associated. When we have been pricked more than once they are generalised into concepts, and the sight or touch of a pin henceforth arouses a volition prompting us to avoid treading on it or sticking it into our finger. Here, according to previous admission, the idea of the pin is derived from the phenomenal object, and the concept from the union of two or more ideas. And if we shut our eyes no pin will be seen, and no visual mental image formed, so that the intervention of the eye is a necessary link in the chain. In like manner the pain of the prick is only an intensification of the sense of contact; and if the finger were not presented there would be no prick, and no pain, and therefore no subsequent idea of the pain. So that we have the two chains, of feelings and of phenomena, apparently interfering with each other; we have members of the one set standing in genetic relationship to members of the other. Indeed, as we have seen, this happens whenever an object is succeeded by its correspondent idea.

Two questions here suggest themselves. One is, the old and still unanswered query—Are the pin and the finger too mere mental phantasms, or have they any other kind of existence? The other is—Have we any reason to believe that either chain is broken; that, for instance, a phenomenon may be succeeded by a feeling, coming instead of another phenomenon? Or are the two chains collateral, the appearance of a link in the one being in some way essential to the appearance of a link in the other, yet being always followed by a link of its own kind? The only modifications that the individual can *see* in his body are the puncture and the flowing blood. But does the modification end here? Are there no other physical changes which might be rendered apparent to the senses, if there were anyone to trace them? These questions we can answer only by proceeding to the *third* class of objects.

The Ego is not alone with the body, and with the world of non-sentient objects. Other objects are perceived, resembling in all important particulars the percipient's own body, and appearing to act in a similar manner. When these act on one another *he* does not feel anything, but he cannot help inferring that *they* do; or rather, that feelings resembling his own are connected with these bodies which resemble his own. "How this inference is justified," says Prof. Clifford, "I do not pretend to say." * It cannot be justified by reason, but it is a procedure such as forms the very *basis* of

* In his Essay "On the Nature of Things in Themselves."

reason. We have seen that the formation of concepts is a necessary mental process, and no concept can be formed save by a perception of the analogy between two or more ideas. Concepts, of course, may be true or false, as the analogy is superficial or profound; in this case the more closely the analogy, or rather homology, is investigated, the more profound it appears.

At last, then, we have arrived at something which we can regard as an actual and active existence, independent of the individual Ego, but like it; in fact it is *another* individual Ego. And this inferred existence Prof. Clifford proposes to call the "eject," because, as he says, it is "thrown out" of consciousness.* This seems not a very happy term; however, I shall use it for the present.

All that I know of the "eject" I infer from my observation of that complexus of phenomena which is like my body, and which I call *his* or its body. Now, when I modify that complexus in any way—say by a pin-prick—I find (from signs which I learn to interpret analogically) that I have aroused a train of feelings, resembling those which are aroused when I prick my own finger. These feelings, like my own, are manifestations of some active Entity, and this Entity is not dependent on my mind for existence. The pin-prick, or, as I may call it, the *stimulus*, is genetically connected with this train of feelings, just as the feelings are connected with each other,—sensation with idea, idea with concept,—consequently it must be linked with them by some Entity, some "Ding-an-sich," upon which I have been working. And evidently, when I modified the group of phenomena called the finger, I acted on a part of that Entity. That is, the human body is the manifestation of a "Thing-in-itself." Let us now get rid of the word "eject," and call the body and mind of my fellow-creature, taken together, the *project*.

By further investigation I find (in a way which I need not detail to readers of the "Journal of Science") that the phenomenal or physical chain is unbroken; that the stimulus is followed by the transmission along a nerve of a wave of disturbance; that this passes to the brain, occasioning there new and complex molecular motions, resulting in the sending outward of another nerve-wave, and finally in the contraction of a muscle. I also learn that every psychosis is accompanied by brain-waste; that if the brain be injured, or insufficiently fed, no psychoses are produced; and that if it

* Dr. Lewins has been in the habit of terming it "project," as a substitute for the Kantian "object."

be excited by stimulants the emotions are produced in excess, and the thinking powers, while at first heightened, are afterwards diminished. I find (in the words of Professor Huxley) that "the brain is the organ of sensation, thought, and emotion—*i.e.*, some change in the condition of the matter of this organ is the invariable antecedent of the state of consciousness to which each of these terms is applied." This statement is complete, with Prof. Clifford's important supplement that "some other change is the invariable *concomitant* of sensation, thought, and emotion. The two series—of psychoses and neuroses—are parallel so far as they run together, but they are not co-extensive. There is no psychosis without a corresponding neurosis, but there are neuroses without corresponding psychoses. The psychoses are concomitant with those neuroses only which take place in the brain, though genetically connected with others taking place in remote parts of the body. And neither chain is ever opened to admit the intercalation of a member of the other series.

When we find this mutual influence and parallelism between the two series, and reflect that, while each consists of manifestations of an active Entity, there is yet not a particle of evidence for imagining that there are *two* of these entities running parallel and interacting: when we further consider that this clumsy dualistic supposition can be traced to the fancies and dreams of savages, we shall soon be landed, willingly or unwillingly, in philosophic Monism. We shall be led to the conclusion that there is *one* "Ding-an-sich," of which both mind and body are phenomena; and that an act of this Entity which from one side appears as a change in the condition of the cerebral cortex, from the other side appears as a thought or emotion. *Why* there should be the two sides no one can say; but neither can anyone say why there should be the one side.

Dualism involves not merely the initial assumption of *two* Entities, but a long chain of assumptions, increasing as it proceeds in complexity, difficulty, and inconsistency. For instance, we have to imagine either that Spirit can act and be acted upon by pulls and pushes, or that Matter can act and be acted upon *otherwise* than by pulls and pushes, which, in ordinary experience, constitute the only mode in which it can make or receive impressions. On the former theory Spirit must have material attributes; on the latter Matter must have spiritual attributes. But Spirit with material attributes is conscious Matter; while Matter with spiritual attributes is corporeal Spirit. On either supposition one of the two Entities is superfluous.

The name of the Entity at which we have at last arrived is of very little importance, so long as we clearly recognise the facts. Dr. Lewins, the founder of Hylo-Idealism, terms it matter, and I adopt his nomenclature as the simplest and least misleading. To speak of "Spirit" with Hegel, or "Will" with Schopenhauer, seems to imply the necessary possession of mind or volition, and Herbert Spencer's "Unknowable" has more than a tinge of mysticism.

Not only may an animal exist in an unconscious state, but we are entitled to decide from analogy that a similar independent existence may be ascribed to objects which, so far as we know, are always unconscious, as plants and stones. The so-called "external" world is restored to reality, and, in spite of Mr. Billing's fears, geology and astronomy are quite at liberty to enter the service of Hylo-Idealism.

Every man's world is produced by the interaction of his nervous system with other matter; but it is the activity of the brain that brings the world into consciousness, and prescribes the forms of space, time, and causality under which it shall appear. It is the material brain that gives light and shade, form and colour, extension and solidity to the Cosmos; it is the material brain that procreates the beauty which we love and the sublimity which we worship. Change the human organism, and you have changed the visible and tangible Universe.

Schopenhauer expresses this with great clearness. "Suns and planets," he says, "without an eye that sees them, or an understanding that knows them, may indeed be spoken of in words; but for the idea, the words are absolutely meaningless. . . . . The existence of this whole [phenomenal] world remains ever dependent upon the first eye that opened, even if it were that of an insect. For such an eye is a necessary condition of the possibility of knowledge, and the whole world exists only in and for knowledge, and without it is not even thinkable."

C. N.

(Constance Arden.)

II. WÖHLER AND LIEBIG.

By Miss Kate Windscheid.

THE names Wöhler and Liebig are so inseparably united that their friendship, which has found its fullest expression in their letters to each other, claims our sympathy to a high degree. The correspondence has been for the greater part preserved, and will probably be published ere long. Prof. Hofmann has made known a considerable number of the letters in his essay "In Memoriam of Friedrich Wöhler." By his kind permission I am enabled to make the English public acquainted with such parts of this in every respect highly interesting correspondence as refer to the deep-rooted love and respect which united the two friends, excluding all scientific topics.

At the time when the two men became acquainted Wöhler was Professor at the School of Industry at Berlin, and Liebig Professor at Giessen. They first met at Frankfort in the house of a common friend, and, though their intercourse was but short, they parted firmly convinced of having found a friend for life.

Liebig to Wöhler.

(Answer to a letter not preserved.)

"Giessen, February 11, 1829.

"Dear Doctor,—Your kind letter of January 20th, which I have duly received, has given me the greatest pleasure, as a proof of your lasting friendship. Be assured that I fully respond to your feelings, and that the few hours we spent together at Frankfort will ever be a most agreeable reminiscence to me. I am fully convinced that our friendship will never be subject to an interruption by the skirmishes we have had or may have again. . . . .

"I am sorry to hear that you are unwell. I have suffered for years from the same complaint, which forced me to put a stop to all work in my laboratory. You will learn to take care of yourself only when you shall have a family of your own, and I wish with all my heart that this may soon be the case. You will then attach more importance to your health, which must be precious to everybody that has a heart for Science. I look forward with joy to a line from you.

"Believe me unchangeably yours,

"Liebig."

Wöhler to Liebig.

"June 8, 1829.

"Dear Professor,—Mr. Poggendorff has communicated to me the contents of your last letter, and I am glad thus to find an opportunity of continuing the correspondence that was begun last winter. Really there must be a demon in the case, who takes a certain pleasure in bringing us into collision by our work, and in making the public believe that we are adversaries seeking for apples of discord. He shall not succeed, however. If you like we might begin jointly some chemical work, and publish the results under both our names. The choice of the theme I leave entirely to you. At the end of July I hope to go to Frankfort, and to stop at Giessen, in order to have the pleasure of being once more in your company."

Liebig to Wöhler.

"Giessen, June 12, 1829.

"Your letter of the 8th of June has given me great pleasure. I joyfully accept your proposal of treating in communion the same subject, and shall be most happy to see you here in July, when we can talk over the ways and means more closely."

Only a few months later the friends are enabled to publish the results of their researches. There appeared in 1830 the first work that bears at its head the joint names of Wöhler and Liebig ("On the Composition of Mellitic Acid").

In 1830 the Swedish *savant* Berzelius visited Germany, and Wöhler was most happy to bring his friend into connexion with his former teacher, to whom he was bound by the strongest ties of gratitude.

Wöhler to Liebig.

"Berlin, August 25, 1830.

"Only a few lines in haste, dear friend, to inform you that Berzelius has arrived here yesterday. We all wish that you might go by Berlin on your way to Hamburg. It would give great pleasure to Berzelius, who has charged me to beg you in his name to comply with our request."

Liebig to Wöhler.

"Giessen, August 28, 1830.

"Your idea that I should go by Berlin to Hamburg is very tempting, but impracticable. A Professor at Berlin can afford many things from which a Professor at Giessen must desist. Even my journey to Hamburg is a sacrifice in pecuniary respect. My heart is heavy at the thought that I shall not be allowed to pass some days with Berzelius, you, and our other friends, but I comfort myself with the prospect of seeing the former at Hamburg."

Liebig to Wöhler.

"Giessen, October 12, 1830.

"I am back again at Giessen ready for any work, and longing for news from you. My journey to Hamburg was successful in every respect. Berzelius has received me in the kindest manner, and has authorised me to communicate with him by letter. I only regret my opportunities for confidential conversation with him having been so few. He has quite won my heart by his amiable and unpretending ways, and I perfectly understand your attachment to him. Everything would have been perfect if you had been there."

Wöhler to Liebig.

"Berlin, October 13, 1830.

"Let me (first) thank you sincerely for the kind lines you sent me from Hamburg, which gave me all the more pleasure for their being written on the same sheet with those from a friend, who has long wished to make the acquaintance of a man for whom he entertains the highest consideration."

The following letter must be the answer to one written by Wöhler, which, however, is not to be found in the papers in hand. We can guess, though, pretty well at the nature of the "proposal" which Wöhler has made to Liebig, for in all the following letters (according to the German custom) the brotherly "thou" has taken the place of the conventional "you."

Liebig to Wöhler.

"Giessen, October 19, 1830.

"I wish I could sufficiently express the pleasure which your last letter has given me. I need not add that I most sincerely accept your proposal. I love you as if the ties which bind us had united us from our very youth, and I always did find it difficult not to speak in my letters to you the language of intimacy. You may be convinced that I am yours with all my heart, and that our friendship greatly contributes to my happiness. All I fear is that you will by-and-bye think less highly of me when you will have become aware how very limited is the knowledge I have acquired. You complain of the translation of Berzelius's writings, which, as you say, takes up all your time, and makes work of your own almost an impossibility. Dearest friend, I have long grieved to see that you waste your time on things which are unworthy of yourself, and I regret it all the more as I foresee that they will soon deprive me of your co-operation in our common work. To the deuce with your scribbling; and to the laboratory, where your place is, with yourself."

Wöhler to Liebig.

"Berlin, November 17, 1830.

"You scold me for over-burdening myself, dear friend, without considering that life is much more expensive here than at Giessen. Believe me, that if this were not the case translations and lectures might go to the devil for all I care. I undertook the task, however, at a period when I had much more time to spare and a very small income, and now I am in honour and out of gratitude for Berzelius bound to finish it."

The letter from Liebig to which Wöhler refers in the following lines is not to be found in their correspondence. Undoubtedly Liebig has again reproached his friend with working too much.

Wöhler to Liebig.

"Berlin, December 18, 1830.

"Was there ever anything more funny than the terms on which we stand? We are intimate friends, we work together, we behave rudely or amiably as the occasion offers,

and yet neither has a very clear idea what the other is like; though this is hardly astonishing, considering the lapse of time since we met. These thoughts occur to me while looking over your last letter, which contains reproaches that ought to provoke me if they were not wholly unmerited, and if your kind intention were not peeping out between the lines. All this, however, is necessary to keep up the humorous side of our friendship, and I am very glad that it should be so, and that Science should in some degree profit by it."

In 1831 Wöhler resigned, quite unexpectedly, his functions at Berlin. The reason for this sudden change may partly be found in disagreeable dissensions with his colleagues, and partly in his being overburdened with heterogeneous work, which hindered his indulging in scientific occupation. A school of industry being set up about this time at Cassel, he accepted the proposal of going there as a teacher, on condition that he should lecture on the same subject as at Berlin.

In December, 1831, he writes to Liebig:—"Everything is now most satisfactorily arranged here, and my position at the School of Industry will be the same as at Berlin. My heart ached when I was offered leave of absence for a whole year on condition that I should stay, but for honour's sake I could not act otherwise."

In 1832 Wöhler entered on his functions at Cassel; his innate love for experimental research had revived after a period of rest, and the letters of the two friends abound in new projects; they both know perfectly well that they are mutually dependent on one another.

In the midst of his scientific plans Wöhler is afflicted by a heavy stroke of fate. He loses his young wife after their having been united only for two years. In these hard times friendship is the goal which opens to the shipwrecked men. Liebig does not rest until he knows his almost despairing friend safe under his own hospitable roof; and now the two men work for the first time side by side, and the results of their efforts are deposed in the admirable work on Benzoic Acid.

Wöhler to Liebig.

"Cassel, August 30, 1832.

"I have now returned to my dreary solitude, and do not know how to thank you sufficiently for your love. I have

been supremely happy in working side by side with you, dear friend.

"I send you here enclosed the essay on Amygdalic Oil. The writing of it kept me longer than I thought it would. I beg you will read the whole with great attention, and especially to have an eye on the ciphers and formula. Please change without much ado what does not suit you. I often feel that something is not as it ought to be, but I cannot find the right expression for it."

In 1836 an important change took place in Wöhler's life. He was elected Professor of Chemistry at Göttingen, reaching thus the goal of his ambition—a Professorship at a German University. With renewed zeal Wöhler, seconded by Liebig, devoted himself now to scientific researches, and during the next twenty years a series of eminent discoveries delighted and astonished the world.

It is elevating, indeed, to behold the mutual endeavours of the two *savants* to investigate the realm of Nature. Their working in common only ceased when Liebig began to occupy himself with the application of chemistry to agriculture and physiology. He often regretted, in after times, having abandoned this sphere of action, and the sight of the brilliant discoveries which Wöhler was continually making awakened in his breast a feeling of regret. It is called forth by the consciousness of having exchanged a field of work where laurels bloom for one covered with thorns. His letters from the years 1857 to 1860, when he lived already as a Professor at Munich, fill us with deep sympathy.

Liebig to Wöhler.

"Munich, April 15, 1857.

"Your letters of the 5th and of the 15th sound in my ears like a fairy tale. My youth, years that are past, times that have died away, arise in me and remind me of the time when we worked side by side, joyfully and without envy. You have kept your mind unspotted, you are able to procure for yourself an enjoyment that is ever new, while I feel as though I were a deserter, a renegade who has forsaken his religion. I have left the highway of Science, and my endeavours to be of some use to physiology and agriculture are like rolling the stone of Sisyphus,—it always falls back on my head, and I sometimes despair of being able to make the ground solid."

And in November of the same year :—

"I admire you and your splendid works. How happy you are in your sphere! I am younger than you, and yet far duller. You are like that man in the Indian Fairy Tale out of whose mouth dropped branches of roses when he laughed, while I am condemned, together with the agriculturists, to pour water into the barrel of the Daneïdes. All I do is in vain; I am wasting my best forces, without being cheered by any success whatever."

A great many of the letters exchanged between Wöhler and Liebig refer to the travels they undertook at different periods. In 1843 Wöhler made his first journey to Italy. The enthusiasm which the southern world excited in him is reflected in a letter to Liebig, written on his return.

Wöhler to Liebig.

"Göttingen, October, 1843.

"I am safely back again at home, and do but regret that you have not been with me. I have derived both pleasure and instruction from this journey, the scenery as well as the people being entirely new to me. It is worth while making the voyage if it were only in order to enjoy that view of the blue Adriatic Sea from the heights of Optschina, and the drive down the mountain between olive and fig trees."

In 1846 and 1847 Wöhler went again to Italy, both times extending his journey as far as Naples. When he prepared to go for the second time to this beautiful country, he tried in vain to persuade Liebig to accompany him. "Your proposal to go to Naples," he writes in June, 1847, "is very tempting, but I am so inconceivably dull that I cannot make up my mind. I am tired of strange faces, and not inclined to worry myself by speaking French. After all, what good will it do to me to have looked into the crater of Mount Vesuvius?"

Wöhler to Liebig.

"Göttingen, July 22, 1847.

"It is actually a relief to me to find you too, for the time being, so very tired of chemistry. You cannot imagine how weary I am,—how sick of the whole concern. Some parts make me yawn when I think of them. What is the cause of this weariness? Have we, then, turned already so very old?

"At any rate it is high time for us to take a good airing, to bathe ourselves in the pure mountain air, and to keep away for some time from everything like chemistry. Your invitation to the Odenwald is very tempting, but Nature there is on too small a scale for me. If I am to recover I must have the sea and snow-covered mountains. Why won't you come to Naples with me? The beauty and splendour of that scenery are beyond all description, and to have stood on the brink of a volcano *is* worth something, for all you say."

In vain; Liebig is not to be persuaded, so Wöhler is forced to undertake the journey in company of another friend.

Wöhler to Liebig.

"Mentone, March 30, 1870.

"The heaven is grey to-day; the wind is in the east; from our windows we can hear the loud surging of the sea; swarms of sea-gulls seek for their prey on the dancing waves. In the end one gets tired of looking at all this, and is quite content to take up a book or to settle down to letter-writing. I am not allowed to go out to-day, having caught cold on a drive to Nice, on a day when the heat was very great. I won't tire you with a description of our journey, which was rather cold until we came to the sea, to Toulon, where we plunged all at once into an abundance of warmth and green leaves. There is hardly anything more beautiful than the railway road along the coast, with the view on the blue sea, with its bays and promontories. At Toulon we saw the first date trees, which stand out so clearly against the blue sky and the sea. Mentone is but a small town, built partly up the steep coast, and containing several good hotels, with beautiful gardens by the sea. In the early morning, when the sun has not yet quite risen and the air is clear, we can see quite distinctly from our windows the hilly coast of Corsica."

When Wöhler is by adverse circumstances denied the pleasure of travelling with Liebig, he flies to the Lake of Geneva, to his beloved Montreux. In letters to his friend he often speaks of that most beautiful spot "offering the view on the glorious blue lake and the mountains of Savoie."

In January, 1872, after having gazed from the window of his study, the garden covered with snow, and the leafless trees that look like broomsticks, he writes to Liebig:—

"It is quite warm already at Montreux, and the most glorious spring weather. I long for the blue lake and the beautiful mountains, and quite understand that Davy and Faraday should have loved this spot so well."

A slight indisposition which befel him in spring obliged Wöhler to put off the desired journey to the autumn of the same year. Liebig was prevented from accompanying him by the preparation for an academic speech.

Wöhler to Liebig.

"Vernex, September 18, 1872.

"It is four days since we have settled down here in one of the most comfortable boarding-houses, with a large garden close by the water. The mountains of Savoie are steeped in light, the lake is perfectly tranquil, and we enjoy with all our might this short space of untroubled existence. At noon, indeed, the heat is very great, and we are obliged to seek the shade of the big plane trees by the lake."

Liebig to Wöhler.

"Munich, September 22, 1872.

"Your letter, which pictures so vividly your residence at Vernex and Montreux, has given me great pleasure, as it clearly shows that the air, the lake, and the comfortable lodgings have strengthened your health. I am very sorry that we have not met this autumn. I had looked forward so much to your coming to see us on your way back."

Again and again the delight which Wöhler took in the contemplation of Nature is reflected in his letters to Liebig, breaking forth in exultation when he speaks of the South of Italy:—

"On the highest summit of the Blue Mountain stands the palace of Tiberius, in whose shade I ate splendid grapes and figs, while two brown-faced girls, the guides of our horses, danced the Tarantella to the sound of the tambourine. The view from there on the blue sea, on the gulfs of Naples and Salerno, on the promontory where Circe tried by her singing to seduce Ulysses, is something heavenly in its beauty,—words are not strong enough to describe this splendour."

Besides the repeated journeys to Italy, Wöhler visited England in 1835. Though the letter in which he describes his stay is not addressed to Liebig, but to Professor Dr. Hofmann, it may be yet of interest to an English public:—

"I shall always remember with pleasure the journey I made to England in 1835. We visited several technical establishments at Worcester, Birmingham, and Manchester, and travelled to Liverpool by railway, the only one that then existed in England, and which excited our wondering admiration. Faraday, who received us most amiably, and conducted us personally through several manufactories, had provided us with letters of recommendation. When we first visited him he took me for the son of the Wöhler he had heard of, because I was so thin as to look very young. In London we saw Prout, in Manchester the old Dalton."

Let us now dwell for a moment on those letters which speak of the mutual respect and love of the two *savants*. How sincere a friendship united them is proved by their readiness to give and to take advice. It is especially Liebig who consults his friend in every doubtful case. He publishes nothing without having first asked his opinion.

Liebig to Wöhler.

"Giessen, March 20, 1841.

"Your letter has been a great comfort to me. If you consider how great an influence you exercise on my ideas and on my work, how a mere point of interrogation from you sets me off on a train of thought, you can well imagine my joy on finding that your former experiences have led you to no conclusions that are contrary to those at which I have arrived. If your intelligence does not tell me that I am on the wrong track—and that was exactly what I wished to hear—I have courage enough to proceed.

"I have spent a whole day in developing to you my views on alimentation and respiration. You will see that they are contrary to everything which I have formerly admitted, but I am convinced of their correctness, and verily believe that they form the foundation of physiology and pathology."

How great a treasure Liebig possessed in the friendship of his companion is best shown by the remonstrances which Wöhler is never tired of making to his vehement friend. The following letter he addressed to him in the beginning of the quarrel between Liebig and Mitscherlich :—

"Cassel, March 3, 1834.

"I have just received a letter from Poggendorff, who urgently desires me to join him in begging you to leave your paper against Mitscherlich unfinished. Though he has communicated to me its contents only quite in general, I am horrified at the thought of the scandal you are about to begin. Granted that you are perfectly in the right, that scientifically as well as personally you have cause to complain, by doing this you stoop from the elevated position in which posterity will see you to a vulgar sphere, where the lustre of your merits is sullied. I hope you won't believe that I want to flatter you. Do not think that your attacks will harm Mitscherlich in the eyes of the world; his real merits, which even you must acknowledge, will always secure him an honourable place, and as in France, as well as in Germany, you have the repute of being quarrelsome, the unfavourable opinion will fall back on yourself.

"Transport yourself into the year 1900, and let us suppose that Mitscherlich has taken no notice of your attacks, and established his reputation still more firmly by successful discoveries. What would you think of yourself, what of him, in reading about the quarrels of the year 1834? What is the good of it? You will annoy Mitscherlich a little, amuse the public, embitter your life, and ruin your health. Believe me that people will only look upon these contests as the outbreaks of a paltry spirit. Good-bye, dear friend, and don't be angry at my sincerity."

Wöhler to Liebig.

"Göttingen, March 9, 1843.

"To contend with Marchand or with somebody else will do you no good whatever, and be of little use to Science. It only makes you angry, and hurts your liver.

"Think of the year 1934: what will it matter, then, whether we have lived in peace or in enmity? who will then care for your quarrels, for the sacrifice of your health and spirits, in the cause of Science? Nobody; but your ideas, the new facts which you have discovered,—that is what will rest in the memory of men, what will always be acknowledged."

A quality especially characteristic of Wöhler, and which rendered him especially dear to his friends, was his perfect modesty. With the utmost energy he refuses what he

believes to be unmerited distinction, and in measure as he keeps his own self in the background the merits of others are brought forward by him.

At the time when Liebig had published the Essays in which he defends his views on Bacon, Wöhler writes to him :—

"I have read them with great pleasure and with real admiration of your talents, which manifest themselves also in this line. It is not want of interest, but want of practice, which makes me slower than you in entering into such questions. The power of imagination is tolerably developed in me, but as to reasoning I am painfully slow. Nobody was less intended by nature for a critic. I do not possess the least mathematical (faculties) and philosophical faculties, though I flatter myself of having a tolerable mechanism for observing in my brain."

Gradually the day has begun to decline. "The shades of eve are falling fast." The future lies no longer like an unbounded plain before the eyes of the two friends, and in their letters to each other is expressed the foreboding of the coming night.

Liebig to Wöhler.

"Munich, January 2, 1869.

"I cannot begin the new year without expressing the wish that heaven may grant us the joy of spending the few years we have still to live in untroubled friendship. The increasing signs of old age warn us to put our houses into order. We are rolling on an inclined plane, and the end is not far off, but nothing will ever change our hearts."

A year later Wöhler writes to Liebig :—

"Göttingen, May 2, 1869.

"Life seems to me like a bad comedy; it bores me, and yet I do not like to leave the theatre, because I always hope that something better may come. 'Give me back my youth,' says the poet in Faust."

With the following words Liebig greeted his friend at the close of the year 1872, when the shadows of the coming separation were already gathering round them :—

"Münich, December 31, 1872.

"I cannot let the old year pass away without expressing the most heartfelt wishes for your welfare and that of your family. We shall not many times more be able to wish each other a happy new year; but even when we shall have died the ties which bind us will unite us, in the remembrance of men, as an example of two *savants* who struggled without envy in the same sphere, ever united by the closest friendship."

Wöhler to Liebig.

"Göttingen, October 30, 1872.

"Many thanks for your last letter, from which I learned that you are pretty well. It is a great bore that in old age one is obliged to attach so much importance to the state of one's health. Thirty, forty years ago nobody ever thought of asking the other whether he felt well. In youth we cannot imagine that life can ever come to an end, and it would be just the same in old age if the decrease of strength did not remind man of his approaching end."

On April 3rd, 1873, Wöhler received the last letter from his friend, whom he outlived for ten years:—

"I meant to have written to you yesterday, but I had a wakeful night, and spent the day on the sofa thinking of you. Is it possible, I wonder, to die in old age from want of sleep, without any acute illness? The lamp goes out gradually, when the body is no longer fortified by the vegetative life it leads during the night."

On the 18th of April the news of Liebig's death reached Wöhler at Hanau.

The correspondence between Wöhler and Liebig, of which fragmentary letters have been produced here, embraces a period of more than fifty years, and fills us with sincere admiration for them. Not a word in these hundreds of letters that they might wish not to have written; unselfish friendship, true love of mankind pervade these leaves; and, besides, they give us a clearly defined picture of the two friends so widely different in character, and yet so closely united.

Liebig a fiery, impetuous spirit, seizing with enthusiasm

every new idea, obstinately defending his conviction, yet grateful to whoever convinced him of his error.

Wöhler cool, deliberate, expressing his opinion, but after elaborate examination which seems to exclude the possibility of his being mistaken.

Liebig nervous, flying into a passion at a slight provocation, and consequently often engaged in violent controversy.

Wöhler passionless, imperturbable, a sworn enemy of quarrels and disputes.

The qualities, however, which they both possessed in an equally high degree were love of truth and loyalty. Is it then astonishing that between these two men, that were so entirely dissimilar, there should have blossomed up a friendship which both reckoned among the greatest blessings of their lives. Their mutual attachment, which was based on the highest personal respect, has become to all who have been granted the favour of knowing them more intimately a model for emulation.

III. ON THUNDERBOLTS.

By Colonel the Honourable ARTHUR PARNELL (late Royal Engineers.)

IN regard to the true meaning of the expression which forms the title of this paper a very erroneous idea seems to be prevalent, and especially among men possessed in other respects of scientific attainments. To illustrate this statement I would refer to the following instances. In "Symons's Meteorological Magazine" for August, 1880, the editor, Mr. G. J. Symons, F.R.S., then President of the Royal Meteorological Society, says:—"Thunderbolts do not exist. I have been trying to find one for a quarter of a century, and have always failed." At a meeting of the North of England Mining Engineers' Institute at Newcastle-on-Tyne, in December, 1883, at which I was present, Professor Lebour, of the Durham University College of Physical Science, informed the audience that a thunderbolt was a

piece of iron pyrites. At a meeting of the Royal Institute of British Architects held in January, 1884, Professor D. E. Hughes, F.R.S. (a member of the recent "Lightning Rod Conference"), in discussing a paper I had just read, said that he had long been trying to find a thunderbolt, and that he should much like to see one. And in an anonymous article "On Thunderbolts," in the "Cornhill Magazine" for November, 1884, a writer devotes several pages in attempting to demonstrate that thunderbolts have no existence.

Now, in all these cases the speakers or writers have taken for granted that a thunderbolt is the same as a *thunderstone*, *viz.*, a material projectile fabulously supposed in some of the darker ages to have been occasionally emitted by a lightning stroke. On what grounds such a confusion of terms should have been permitted to develope itself among men whose special business it is to keep the public rightly informed on such matters baffles my comprehension. For it is only necessary to turn to any standard English dictionary in order to obtain a correct knowledge of the real signification of the old English words *thunderbolt* and *thunderstone*.

Perhaps the readers of the "Journal of Science" will pardon me if I here adduce *verbatim* extracts from a few of these classical mines.

(1). Johnson's Dictionary, Todd's Edition, 1827.

Thunderbolt. "Thunder and bolt as it signifies an arrow. Lightning. The arrows of Heaven."

Thunderstone. "A stone fabulously supposed to be emitted by thunder."

(2). Webster's Dictionary, 1841.

Thunderbolt. "A shaft of lightning; a brilliant stream of the electric fluid passing from one part of the heavens to another, and particularly from the clouds to the earth."

Thunderstone. A stone, otherwise called *brontia*.

(3). Craig's Dictionary, 1848.

Thunderbolt. "A brilliant stream of the electric fluid, particularly if acting in a direction towards earth."

Thunderstone. "A stone fabulously supposed to be emitted by thunder; they are a crystallised iron pyrites of cylindrical form found in all chalk beds."

(4). Chambers's Dictionary, 1877.

Thunderbolt. "A shaft of lightning (particularly if

passing in a direction towards the earth); figuratively, something sudden and irresistible."

Thunderstone. "A variety of crystallized iron pyrites."

(5). WORCESTER'S DICTIONARY, 1881.

Thunderbolt. "A brilliant stream of lightning. A bolt of lightning."

Thunderstone. "A stone fabulously supposed to be emitted by thunder. Crystallized iron pyrites."

Probably these quotations will be considered sufficient to justify the charge I have brought forward, and to render it obvious that a thunderbolt is in reality merely a lightning stroke. I propose, however, to submit, in addition, some quotations from our two great wells of English undefiled, *i.e.*, The Bible and Shakespeare's Plays, with a view of showing that the lexicological interpretation which I have just enunciated is no mere pedantic fancy of the philologists who compiled these dictionaries. In the Scriptures the term is only once mentioned; but that once is cogently explicit. In Psalm lxxviii., 48, we read: "He gave up their cattle also to the hail, and their flocks to hot thunderbolts." That the translators intended to use this expression as synonymous with lightning strokes is clearly proved by the marginal correction which substitutes "lightnings" for "hot thunderbolts."

Shakespeare uses *thunderbolt* or *bolt* in the ten following instances.

Tempest, II. 2 [Caliban *loq.*]. "This is no fish, but an islander that hath lately suffered by a thunderbolt."

As You Like It, I. 2 [Celia *loq.*]. "If I had a thunderbolt in mine eye, I can tell who should down."

Henry IV. (Pt. I.) IV. 1 [Hotspur *loq.*]. "Come let me take my horse, who is to bear me, like a thunderbolt, against the bosom of the Prince of Wales."

Julius Cæsar, IV. 3. [Brutus *loq.*]. "Be ready, gods, with all your thunderbolts; dash him to pieces!"

King Lear, III. 2 [Lear *loq.*]. "You sulphurous and thought-executing fires, vaunt couriers to oak-cleaving thunderbolts, singe my white head!"

Antony and Cleopatra, II. 5 [Cleop. *loq.*]. "Some innocents 'scape not the thunderbolt."

Tempest, V. 46. [Prospero *loq.*]. "To the dread rattling thunder have I given fire, and rifted "Jove's stout oak with his own bolt."

Measure for Measure, II. 2 [Isabella *loq.*] "Merciful heaven! thou, rather, with thy sharp and sulphurous bolt, splitt'st the unwedgeable and gnarled oak than the soft myrtle."

Coriolanus, V. 3 [Volumnia *loq.*]. "To tear with thunder the wide cheeks o' the air, and yet to charge thy sulphur with a bolt that should but rive an oak."

Cymbeline, V. 4 [Jupiter *loq.*]. "How dare you, ghosts, accuse the thunderer, whose bolt you know, sky-planted, batters all rebelling coasts?"

I would suggest that in no one of these extracts does Shakespeare give the reader the idea of any other action than that of an ordinary lightning stroke, or of the irresistible force that (with the utmost physical accuracy) such a stroke may figuratively be supposed to typify. But to render it more certain that this master of the English tongue knew well the difference between such a stroke or bolt of force as I contend he has in the foregoing sentences been alluding to and the material bolt of which a thunderstone might convey the impression, I will now give two instances in which the poet actually mentions the latter term.

Cymbeline, IV. 2 [Guiderius *loq.*] "Fear no more the lightning flash." [Arviragus *loq.*]. "Nor the all-dreaded thunderstone."

Julius Cæsar, I. 3 [Cassius *loq.*]. "And thus unbraced, Casca, as you see, have bar'd my bosom to the thunderstone."

Moreover, if my researches be accurate, Shakespeare, throughout his Plays, only makes twelve allusions to strokes of lightning; in no less than ten of these he uses the term *thunderbolt* to set forth his meaning; and only in two of them does he employ the expression *lightning.* He mentions this last word altogether on fifteen occasions, of which eleven are in connection with the principal physical element of lightning, *viz.*, light; two are in respect of its heating qualities, and two (as aforesaid) to denote the stroke or explosion of which lightning is usually the accompaniment.

In regard to the use of the term *thunderbolt* to signify a lightning stroke, by writers on physical science, I am under the impression that during the last century, and long after a knowledge of electricity had spread over the world, the word was by no means infrequently availed of, but at present I can only lay my hands on two examples. The

first is a very important one, and consists of a *dictum* by the famous Dr. Joseph Priestley, F.R.S., in his "History of Electricity," 4th edition, London, 1775. Speaking of the analogy between a lightning flash and the electric spark, he observes: "It was Dr. Franklin who first proposed a method of verifying this hypothesis, entertaining the bold thought" . . . "that pointed iron rods fixed in the air, when the atmosphere was loaded with lightning, might draw from it *the matter of the thunderbolt*, and discharge it without noise or danger into the immense body of the earth. [Hist. p. 164]. It is clear that the "matter" here alluded to is the electricity causing the lightning stroke, or thunderbolt. The other case is the account of a lightning stroke at Holbeck, near Leeds, on September 1st, 1672, when a child (playing with others) was killed, his companions being badly burnt. The narrative is supplied to the "Philosophical Transactions of the Royal Society" (xxii., 578) by Mr. R. Thoresby, F.R.S., who quotes the parish register which records that the child was "slain by a *thunderbolt*." It is abundantly clear from the context that there was no stone or material bolt present, and that neither Mr. Thoresby nor the parish authorities had the faintest idea of any other agency than that of an ordinary lightning stroke.

But perhaps the most curious circumstance connected with the mistaking of thunderbolts for thunderstones is the complete manner in which the expressions employed by the French are ignored. It is hard to imagine that any man should allow himself to be accepted as an authority on the science of lightning strokes who had not studied French works on the subject, but it is certain that any such student could not but have noticed that the French almost invariably use the term *la foudre* to designate a *stroke* of lightning, whilst for lightning itself they employ a totally different word, *viz.*, *l'éclair*. They thus differ entirely from the slip-shod English practice of the present day of adopting the term *lightning* both for the stroke and also for its flash or luminous accompaniment. But what is the English translation of *la foudre*—the translation given by every French dictionary? Why, nothing else than *thunderbolt.* It would appear then that, whilst originally in both languages a scientific distinction was maintained between the stroke and its accompanying light, such distinction has in recent years been permitted in the less scientific country to drop, and that, on the strength of this negligence, English men of science have lapsed into a complete ignorance of the

existence in their language of a word corresponding to *la foudre* in the French tongue. To show again that the term *thunderbolt* is not a dictionary-maker's refinement for the translation of *la foudre*, I beg to call attention to the English version of Arago's "Meteorological Essays," compiled by the late Sir Edward Sabine, President of the Royal Society (London, 1855.) In this translation "la foudre" is repeatedly rendered by the word "thunderbolt." For instance, "Seneca defined *thunderbolts* as lightnings that reach the ground" [p. 24 abridged]. "Maffei, Chappe, and others, deem that" . . . "*thunderbolts* are almost always elaborated on the ground." [p. 101.] "*Thunderbolts* develope by their action, in the places where the explosion takes place, often smoke, and almost always a strong odour." [p. 62] "I admit, without reservation, the existence of ascending *thunderbolts*." [p. 176]. And, lest it should be conceived that the term *la foudre* was used by the French for thunderstones as well as for thunderbolts, I may here mention that their expression for thunderstone is *météorolithe*, a word which seems to give the so-called thunderstone what is probably its true scientific *status*, *viz.*, that of a meteorite or aerolite.

It may now, however, reasonably be asked whether, supposing the word "thunderbolt" to be the proper English term for a lightning stroke, it is even then an expedient one to restore to general use. In reply, I should be inclined to give my opinion in the negative. An erroneous meaning having once been attached to it by scientific authorities, there would probably be some difficulty in rehabilitating it with its correct signification, and I think that the expression *lightning stroke* would, for the present, and until our knowledge of terrestrial dynamics becomes enlarged, be more fitting for general adoption. But I would submit that no objection should ever be urged to the employment by educated men of the legitimate, old-fashioned term *thunderbolt*, should they desire to use it. And I would urge this the more particularly inasmuch as I think that the word represents with scientific accuracy the principal characteristics of all lightning strokes. These appear to me, so far as my researches have extended, to be first a clap of *thunder* of exceeding loudness, and secondly a figurative *bolt* or arrow of irresistible force piercing or rending the materials with which it comes in contact. There are on record several undeniable lightning strokes or thunderbolts in which no lightning has been seen; but I doubt if any strokes can be found in which no thunderclap was heard. And as regards

the second characteristic, it is certain that the records of mechanical force or violence on the part of strokes greatly outnumber those of heating action. Probably the term which eventually will be found to combine precision and simplicity in the highest degree will be *earth stroke;* for there is an overwhelming mass of evidence to show that lightning strokes spring from the earth, and that the direction of their force is invariably upwards. In fact, Nature in this matter amply testifies to the theory deduced from laboratory experiments by the great philosopher Symmer 125 years ago.

In conclusion, I would observe, in regard to the article in the "Cornhill Magazine" already alluded to, that it seems a little remarkable that any man of ordinary reasoning power should deliberately write a paper in a periodical of reputation purporting to prove that thunderstones had no existence. Who ever for a moment doubted the fact? He finishes his contribution with a notice of lightning rods, and eulogises what he considers to be their beneficent action. It is not easy to see what thunderstones have to do with these apparatus; but the writer, after a misleading account of their origin, winds up his dissertation on them with the words, "from the moment the thunderbolt was safely dead and buried." A more shallow scientific production than this paper it would be difficult to conceive, even among the contents of popular magazines usually devoted to the interests of fiction.

November 6, 1884.

IV. AN EXEGESIS OF DARWINISM.

By Oswald Dawson.

UPON the 24th of November last—that is, one week ago—the "Origin of Species" entered upon the second quarter of a century of published existence. I propose to celebrate the event by writing an exegesis; sentimental regard for this period of years, as for a silver wedding, being, however, perhaps less incentive to now

undertake the task than the fact that the colossal statue of Mr. Charles Darwin, by Mr. Boehm, which is to be erected in the British Museum (Natural History), is nearly finished. At such an hour a definition of Darwinism, sufficiently succinct for mnemonical purposes and amply substantiated by copious quotations, may be especially useful.

The word Darwinism has divers significations, and probably to many persons a somewhat indefinite one. It may invoke the image of "our cousin the gorilla" rubbing off its tail by friction, or elicit a taunt that we cannot specify the whence of the nebulæ. Some persons identify Darwinism with Natural Selection, others with Evolution, while Mr. Darwin's approved epitomiser warns us that "we must not confuse the Darwinian theory with Evolution;" for indeed we "cannot, strange as this may seem, call Charles Darwin an Evolutionist" when rightly employing that term. In a pamphlet on "England and Egypt" Mr. B. Fossett Lock, of the Positivist School, "analysed the Liberal party . . . into four groups, . . . Whig, Nonconformist, Darwinian, and Positivist." Long ago "the expression 'Darwinism' (as employed for example by the poet Coleridge when writing on Stillingfleet) was accepted in England nearly as the antithesis of sober biological investigation." Sir Wm. Thomson "out-Darwined Darwin" in suggesting the dispersal of living germs from another planet. Prof. Huxley doubts if he can ever have seen one of Dr. St. George Mivart's "absolute and pure Darwinians" alive. According to one critic Prof. Huxley "is much more Darwinian than Mr. Darwin himself;" according to another critic "Darwin himself is not a good Darwinian," inasmuch as "Darwinism is becoming Owenism." To these significations of Darwinism must be added the following definition :—

From one to at most ten (*vide* Section 1, *infra*) pre-Cambrian (v. 2, *infra*) presumably unicellular organisms (v. 3), created (v. 4) and vivified by the Creator's breath (v. 5), have arisen without any subsequent interference (v. 6), and we can hardly believe otherwise than without beneficent guidance (v. 7), the structures and the bodily and mental (v. 8) activities of all organisms, by the accumulation, mainly by Natural Selection (v. 9), of variations so minute as to be appreciable only to well-trained eyes (v. 10), occurring in correlation but not in co-ordination with related variations (v. 11) affecting single individuals (v. 12), inducing intermittent modification (v. 13), and being determined in their nature by an innate idiosyncratic plasticity (v. 14), the chief ultimate cause of which is probably the accumulating

action of changing conditions upon the parents, but more especially remoter ancestors, of the varying individual (v. 15).

1. "It is immaterial whether or not it be accepted" that "some one primordial form" or several forms commenced the career of life upon this earth.—("Origin of Species," * p. 425). Analogy, which "may be a deceitful guide" (p. 424), and Maupertuis's axiom of least action (p. 423, i., 13) favour the former view. Mr Darwin "believes that animals are descended from at most only four or five progenitors, and plants from an equal or lesser number" (p. 424), though "he does not wish to lay much stress upon the greater simplicity of the view of a few forms or of one form only having been originally created, instead of innumerable miraculous creations having been necessary at innumerable periods" (i., 12).

2. It was not that each geological epoch was honoured by the vivification of a prototype; the several prototypes were "some few beings which lived long before the first bed of the Cambrian system was deposited" (p. 428).

3. "A cabbage may have been the parent plant, a fish the parent animal—it may have been a whale," remarked the "Athenæum;" and I once read that in Church Congress a Fellow of the Royal Society had solemnly urged the claims of the elephant. And, indeed, what more natural supposition than that Mr. Darwin assumed a plurality of prototypes to account for the wider differences between the several subkingdoms? It appears, however, that they were unicellular organisms, for firstly, in the same paragraph in which he contends for the evolution of "each great kingdom, such as the Vertebrata, Articulata, &c.," on embryological (and other) grounds, he remarks that "all organisms start from a common origin; . . . the germinal vesicle is the same" (p. 425): secondly, enquiring how could differentiation succeed the dawn of life, he says, "Mr. Herbert Spencer would probably answer that as soon as simple unicellar organism came by growth and division to be compounded of several cells," &c. (p. 100); the implication being that Mr. Darwin himself starts with simple unicellar organism: thirdly, if the Foraminifera "could be proved to have come into existence during the Laurentian epoch" the circumstance would be fatal to "my view" (p. 308). Why then did Mr.

* Sixth Edition, with Additions and Corrections to 1872. The title will be omitted in subsequent references. Pages preceded by the numerals i. or ii. refer to the first or second volume of the "Variation of Animals and Plants under Domestication," Second Edition, revised, 1875.

Darwin offer us the alternative of a plurality? and further specify "only four or five progenitors" for animals? He writes:—"If at the first commencement of life many different forms were evolved, . . . we may conclude that only a very few have left modified descendants. For as I have recently remarked in regard to the members of each great kingdom, such as the Vertebrata, Articulata, &c., we have distinct evidence in their embryological, homologous, and rudimentary structures, that within each kingdom all the members are descended from a single progenitor (p. 425). Again, certainly we ought not "to believe that innumerable beings *within each great class** have been created with plain, but deceptive, marks of descent from a single parent" (p. 423). "But as the members of quite distinct classes have something in common in structure, and much in common in function, analogy would lead us *one step farther*, and to infer as probable that all living beings are descended from a single prototype" (i., 13); a comparatively precipitous "one step." In the first edition of the "Origin of Species" we were informed that "at the most remote geological period, the Earth may have been as well peopled with many species of many genera, families, orders, and classes, as at the present day" (p. 126; *cf.* 6 ed., p. 97).

4. "Mr. Darwin does not inform us whether he believes the Creator made the original progenitor of all living beings, and then breathed into it the breath of life, or whether it was produced spontaneously without life, and then life was breathed into it. If the former, then we have the Creator making, breathing into, and dropping into the water, the lonely protozoic Adam, that is to be 'the father of all living,' a microscopic gelatinous globule, the single tenant of a boundless ocean." (See, however, p. 422, and ed. i., 466. *Cf.* ed. 6, 410, and i., 12, which seem to imply literal creation.

5. See last sentence of "Origin of Species," which is not only "so distinctly anthropomorphic," but somewhat *theological*. Mr. Charles C. Cattell, secretary of the Darwin Institute, Birmingham, shall speak on this matter. "The early works of Darwin contain a phrase, 'Life breathed by a Creator into a few forms,' and Moses says of Adam, 'God breathed into his nostrils the breath of life.' On this slender foundation is built the immense superstructure that Darwin and Moses are in agreement."

The previous collation of passages concerning the nature

* The italics are mine throughout unless otherwise specified.

of the prototypes should prepare us to encounter ambiguity concerning their origin; and indeed one passage, if literally construed, upsets the special vivification notion. Mr. Darwin thought that "it accords better with what we know of the laws *impressed on matter* by the Creator, that the *production* and extinction *of the past* and present inhabitants of the world should have been due to secondary causes" (p. 428). He tells us that "Science *as yet* throws no light on the far higher *problem* of the essence or origin of life" (p. 421). "How a nerve comes to be sensitive to light hardly concerns us more than how life itself originated" (p. 144). The patent ambiguity, transparent scepticism, and naked indifference of these passages would not gratify anyone who had performed the breathing feat in question.

Assuming that the courageous Mr. Henry G. Atkinson is mistaken in believing that Mr. Darwin's invocation of a Creator to start life upon earth was a mere subterfuge, let us enquire whether or no that vivification endowed the prototypes with anything more than life—and perhaps prestige; was it the cause of the "innate variations" (p. 115), "innate wide flexibility of constitution" (p. 114), and "innate tendency to new variations"? This question will be answered in section 15. Meanwhile it will suffice to remark that Mr. Henry G. Atkinson is not the only traducer of Mr. Darwin respecting this vivification matter. From a diametrically opposite quarter, namely from a current "Dublin Reviewer," we have a questioning of Mr. Darwin's sincerity; while, to turn to avowed applauders, in the second "Agnostic Annual," just issued, the Secretary of the Darwin Institute, Birmingham, remarks that "The *early* works of Darwin contain a phrase, "Life breathed by the Creator into a few forms; . . . Those who quote Darwin as giving a supernatural personal origin to life should be reminded that in his 'Descent' he describes the enquiry as to 'how life itself first originated' as 'hopeless,' and says that the solution lies in the 'distant future,' if it is ever to be 'solved by man." The president of that institute classifies "the late Charles Darwin as one "of the *genus Humbug*," of a variety whose characteristics include "entire unbelief in the supernatural *at heart*." The editor of the "Annual" affirms that "the origin of life is untraceable, and absolutely inconceivable."

6. "As all the forms of life are the lineal descendants of those which lived long before the Cambrian epoch, we may feel certain that the ordinary succession by generation has never once been broken" (p. 428).

7. "However much we may wish it, we can hardly follow Professor Asa Gray in his belief 'that variation has been led along certain beneficial lines,' like a stream 'along definite and useful lines of irrigation.' . . . On the other hand an omnipotent and omniscient Creator ordains everything and foresees everything" (ii., 428). "The understanding revolts at such a conclusion" as that the origin of species is "the result of blind chance," "whether or not we are able to believe that every slight variation" was foreordained. ("Descent of Man," p. 613.) That an omniscient Creator foresees everything is a truism; we may also allow that an omnipotent Creator ordains everything. A third attribute—all-wise, and a fourth—all-beneficent, are, however, essential to a God proper. Neglect to exercise power solves the problem as easily as Mr. John Stuart Mill's tentative "hypothesis that the Creator is a being of limited power," displaying "benevolent design limited by obstacles," as he himself worded it in a recently-published letter to Mr. R. Pharazyn. It behoves me to marshal the evidences of Mr. Darwin's theism, and his indictment of the wisdom and beneficence of God.

Three quotations face the title-page of the "Origin of Species." The first is from a "Bridgewater Treatise"; the second from the "Analogy of Revealed Religion"; the third is a recommendation to obtain proficience in science and divinity. If Mr. Darwin entertained the views to which he gave such conspicuity, he thought that divine power is exerted in the establishment of general laws; that an intelligent agent effects natural results continually or at stated times; that a man cannot be too well studied in the literal book of God's word. Professor Asa Gray inferred that "the most candid of men" adopted the Whewell and Butler quotations as "postulate mottoes," and the Rev. Joseph Cook regards the concord of "the foremost naturalist of our times and the greatest modern Christian apologist" as "a fact in which much solace for timid Christians, and much taming anodyne for audacious small philosophers, lie capsulate." "This renowned passage has become in a new degree famous by being adopted through numberless editions as the postulate motto on the title-page of Darwin's 'Origin of Species.' It stands there as a headlight." This is quite natural inference if we believe the motto was adopted by one "whose greatest praise is that he was, before and above all things, *an honest man* (the italics are not mine, but a *Westminster Reviewer's*); by one "possessed of a certain intense and almost passionate honesty by which all his

thoughts were irradiated as by a central fire." A similar inference, however, is unwarrantable respecting the Bacon quotation. When we take the recommendation to obtain proficience in "the book of God's word . . . divinity" in conjunction with the implication that the impression that the doctrines of the "Origin of Species" would be subversive of revealed religion would be transient, and that this transiency was a matter for satisfaction (pp. 421, 422), we can comprehend why the *Quarterly Reviewer* should affirm that "Mr. Darwin writes as a Christian, and we doubt not that he is one."

In the study of his home at Down during the afternoon of Wednesday, the 28th day of September, 281 years after Bruno was burned, Charles Darwin, in the presence of Dr. Ludwig Büchner, Dr. Edward Aveling, and Dr. Francis Darwin, declared that he had given up Christianity when forty years of age. Visitors to Westminster Abbey may ascertain that Mr. Darwin's fortieth birthday anniversary was a decade anterior to 1859. The Bacon and Leibnitz quotations being, therefore, calculated to mislead; we may not, I think, consider that Mr. Darwin "postulated" theism on the strength of the Whewell and Butler quotations. Was he, then, Theist by induction? In answering this question in the negative I may refer to his repeated comments on the supplanting of indigenes by intruders, though the former "are commonly looked at as specially created and adapted for their own country" (p. 89); to his quotation of "the remarkable words of Helmholtz, whose judgment no one will dispute," concerning the imperfection of the human eye; to his exclamation, "can we consider the sting of the bee as perfect?" "can we admire the production, for [a] single purpose, of thousands of drones, which are utterly useless to the community for any other purpose?" or the elaboration of dense clouds of pollen by our fir trees, so that a few granules might be wafted on to the ovules (pp. 163, 164); to his remark that "To grant to species the special power of producing hybrids, and then to stop their further propagation by different degrees of sterility, not strictly related to the facility of the first union between the parents, *seems a strange arrangement*" (p. 245); to similar remarks as to prepotence in reciprocal crosses (p. 247); to his remark that Nature betrays what in mechanical invention would be "the *blunders* of numerous workmen" (p. 426), &c. (pp. 154, 104), as well as to chapters xii., xiii., and xiv. *passim.* Also to a series of quotations of another category touching a blacker matter than want of wisdom: to his

recognition of the fact that nature evolves contrivances "*abhorrent to our ideas of fitness*" (p. 415); to his remark that "to my imagination it is *far more satisfactory* to look at such instincts as the young cuckoo ejecting its foster brothers—ants making slaves—the larvæ of ichneumonidæ feeding within the live bodies of caterpillars—['cats playing with mice, otters and cormorants with living fish'] not as specially endowed or created instincts" (p. 234 and "Posthumous Essay on Instinct"; to his implication that the existence of "many instincts causing other animals *to suffer*" is incompatible with special creation (p. 417); to his letter to N. D. Doedes; to his affirmation that he was with Dr. Ludwig Büchner and Dr. Edward Aveling—avowed Atheists—in thought, though preferring the term "Agnostic," the date of his deprivation of God, or the knowledge of God, or whatever else a conversion to Agnosticism denotes, being, however, not specified. Perhaps, indeed, Darwinism is theistic after all. The remark that certain characteristics of the *Equidæ* make "the works of God a mere mockery and deception" if "each equine species were independently created" (p. 130), and that if natural selection operate widely and long "may we not believe that a living optical instrument might be formed as superior to one of glass as the works of the Creator are to those of man?" (p. 146); and sundry passages in the "Descent of Man" are indications of theistic belief. And, indeed, "we may console ourselves" for "the happy survive" (p. 61) "from the war of nature, from famine and death, the most exalted object we are capable of conceiving, namely, the production of the higher animals, directly follows" (p. 429). Mr. Darwin would have praised a man who picked pockets in order to pay his creditors ten shillings in the pound.

8. Mr. Darwin has "nothing to do with the origin of the mental powers," being "only concerned with the diversities of instinct and of the other mental faculties in animals of *the same class*" (p. 205). Seeing, however, that "what manner the mental powers were first developed *in the lowest organisms* is as hopeless an enquiry as how itself first originated, although the first dawnings of intelligence, according to Mr. Herbert Spencer, have been developed through the multiplication and co-ordination of reflex actions" ("Descent of Man," pp. 66, 67); and seeing that "*all* the most complex and wonderful instincts have originated" by natural selection (p. 206); we may infer accordingly the calibre of the prototypal instincts.

9. Mr. Darwin "placed in a most conspicuous position—

namely, at the close of the introduction—the following words: "I am convinced that natural selection has 'been the main, but not the exclusive, means of modification.'" (p. 421). Of course, by totally ignoring the ancillary factors an amusing picture of Darwinism can most readily be drawn.

10. Of the principle of selection by man the "importance consists in the great effect produced by the accumulation in one direction, during successive generations, of differences *absolutely inappreciable* to an uneducated eye—differences which I, for one, have vainly attempted to appreciate" (p. 23; to same effect, ii., 177). Let "no man say that any character is too trifling to be methodically attended to" (ii., 195). The production of new breeds "through the action of unconscious and methodical selection, has been *almost insensibly slow*" (ii., 231). Natural selection assimilates unconscious rather than methodical selection; it is more important for our purpose (p. 25). Methodical selection acts comparatively quickly, unconscious selection slowly (p. 32), natural selection presumably still slower (p. 270). "The slow and *insensible* changes [of unconscious selection] can never be recognised unless actual measurements or careful drawings of the breed have been made long ago, which may serve for comparison" (p. 25). Variation under nature has been slow in comparison with variation under domestication; "slight variations" occur "in a lesser degree" under nature (p. 62), and man is not so rigid in his selection as nature (p. 65); "under domestication, it may be truly said that the whole organisation *becomes*, in some degree plastic (p. 62) to same effect, pp. 9, 201, ii., 414; domesticated organisms are *much more liable to slight deviations of structures*, and to monstrosities, than species living under their natural conditions" (ii., 413, also p. 106); "no one doubts" this (ii., 241). "Some animals and plants withstand domestication or cultivation, and vary very slightly, *perhaps hardly more than in a state of nature*" (pp. 7-8). Thus the goose has a "small capacity of variability" (ii., 401; i., 303); yet the goose varies more than almost any wild bird (ii., 241). Birds, in fact, "vary extremely little" (p. 120).

We shall presently see that the ultimate cause of variation is the action of changing conditions. Now, domesticated animals can hardly have been exposed to greater changes of life than have many natural species during the incessant geological, geographical, and climatal change to which the world has been subject; but domesticated pro-

ductions will have often have been exposed to more sudden and to less continuously uniform conditions" (ii., 401). We shall also presently see that Mr. Darwin considers lasting rather than sudden influence to be the inducement of the tendency to vary.

For further evidence that "natural selection acts *only* by the preservation and accumulation of small" (p. 75)—["*infinitesimally* small" ed. i. p. 95] variations, consult the works cited *passim*.

The case is similar as regards instincts; that is to say, "no complex instinct can possibly be produced through natural selection, except by the slow and gradual accumulation of numerous slight, yet profitable variations" (p. 207).

"With respect to the lapse of time not having been sufficient for the assumed amount of organic change . . . this objection, as urged by Sir William Thomson, is probably one of the gravest as yet advanced" (p. 409).

11. In proof of this I may refer to works cited, *passim*; to the ever-recurring phrase "*accumulation* of slight *successive* variations"; to the constant insisting that "there is no necessity for supposing" simultaneity; to his distinction between initial variation and final co-adaptation (ii., 312), and to section 7 *ante*; for the question of co-ordination may be "put out of court" if there be no co-ordinator. Maybe co-ordination does occur now and then—that is, a variation would fail to benefit were it to occur alone, or a prejudicial variation be neutralised by a concomitant one—but it would be accidental—a word often used and well defended by Mr. Darwin; a word like "slight" and "accumulation," which is one of the vertebræ of Darwinism.

12. This is a very important section, and is really one with Section 14.

"The many slight differences which appear in the offspring *of the same parents*, or which it may be presumed have thus arisen, . . . may be called individual differences" (p. 34), and Mr. Darwin "looks at individual differences, though of small interest to the systematist, as *of the highest importance* for us, as being the first steps towards such slight varieties" as ultimately become species (p. 41). "Under the term of 'variations' it must never be forgotten that *mere individual differences* are included" (p. 64, also p. 80); and all "the individuals of the same species differ in some slight degree from each other" (p. 84). We read of variations "useful to *each being's own* welfare" (p. 102); "if any *one being* varies ever so little" it may supplant "some other inhabitant" (p. 143). *Confer* ii., 276. This individual variability

is "shown by every wild animal knowing its mate" (ii., 240), by a chill affecting some men with coughs or colds, others with rheumatism, &c. (pp. 6, 7). *Confer* ii., 279, and for further evidence, as heretofore, to works cited, *passim.*

Mr. Darwin perceived the liability of the obliteration of these variations. In former editions he "*spoke*" as if the preservation of "any single strongly-marked variation" "had frequently occurred," though he "*saw*" that such preservation would be "*a rare event*" (p. 71). "Nevertheless until reading an able and valuable article in the 'North British Review' (1867) [he] did not appreciate *how rarely* single variations, *whether slight or* strongly marked, could be perpetuated" (*ibid.*). Another event, however, occurs "*often*" (p. 72, also ii., 345), namely, "all the individuals of the same species have been similarly modified"—of this there can "be little doubt." "Or only a third, fifth, or tenth part of the individuals may have been thus affected, of which fact several instances could be given. Thus Graba estimates that about one-fifth of the guillemots of the Faroe Islands consist of a variety so well marked that it was formerly ranked as a distinct species under the name of *Uria lacrymans*" (*ibid.*). Why *Uria lacrymans* was not evolved by the "accumulation," or other Darwinian processes, is not stated.

The successor to this characteristic paragraph commences by re-assuring us:—"To the effects of eliminating variations of all kinds I shall have to recur [the subject having already been once postponed (p. 34)]; but it may be here remembered that most animals and plants keep to their proper homes, and do not needlessly *wander about;* we see this even with migratory *birds*, which almost always return to the same spot." He subsequently recurs as promised—to remark that "intercrossing will chiefly affect those animals which unite for each birth and *wander much;* for instance, *birds* (p. 80). And there are "*classes* which unite for each birth and *wander much*" (p. 137).

Animals have not usually to wander any prodigious distance to secure a mate, it may be remarked.

Having admitted that free intercrossing will "check, by blending together, any slight deviation" (p. 11), in summing up he finds that "the result will often be greatly retarded by free intercrossing" (p. 84). In the "Variation under Domestication" he considers the effects "so obvious that they need not be discussed at much length (ii., 62), for "with respect to the very slight differences by which individuals of the same sub-variety, or even of allied varieties, are charac-

terised, it is obvious that free intercrossing would soon obliterate such small distinctions" (ii., 67). The obliteration is, however, "governed by natural selection,"—a proposition perhaps more convenient than intelligible. May it mean that natural selection would favour a varying individual which happened to be pre-potent in the transmission of character? But for such pre-potency there is no guarantee. Another antidote to obliteration is, however, forthcoming,—namely, the tendency of allies to vary in a like manner. Was *the bearing* of this ever recognised by Mr. Darwin?

It better ensures the propagation of a new character if both parents are similarly characterised (i., 460),—"in the great majority of cases a new character . . . is not strongly inherited;" judicious matching is necessary (ii., 177). "In a *few rare* cases peculiarities fail to be inherited, apparently from the force of inheritance being too strong" (i. 465; ii., 58); but when any deviation in structure or constitution is common to both parents, this is often transmitted in an augmented degree to the offspring" (ii., 237).

Let it be "remembered that selection may be applied *to the family*" (p. 230). To obviate the dangers of the breeding of near kin, yet preserve the integrity of the new character, more than one family might advantageously be modified. Happily, then, "we may conclude from the analogy of *ordinary* variations" that "*some few*" are affected (p. 231), or "a third, fifth, or tenth part of the individuals may have been" similarly affected (p. 70). When all or nearly all are affected the result is referable to the direct and definite action of changing conditions (p. 106; ii., 260, &c.); but this is an ancillary factor, or rather (with apologies for sarcasm) a very ancillary factor.

13. The first question is not—Are variations constantly occurring? but, if so, are they being constantly selected? If the variations are of indifferent value, certainly not; but if they favour the possessor the circumstance will determine their selection. Now variation ordinarily being indefinite or promiscuous, the chances are against a succession of indifferent variations. Under domestication any desired character is almost sure to appear (pp. 22, 23, and compare Vilmorin's view, ii., 250). The only remaining factor, therefore, is the struggle; and as "each area is already fully stocked with inhabitants" (pp. 54, 85), while "we do not know that even the most prolific area is fully stocked with specific forms" (p. 101); and as natural selection is "the doctrine of Malthus applied with manifold force to the whole animal

and vegetable kingdoms" (p. 50); and as "it may metaphorically be said that natural selection is daily and hourly scrutinising, throughout the world, the slightest variations" (p. 65); and as organisms "have to struggle for existence from the hour of their birth to that of their death" (ii., 219), one would, variation granted, anticipate incessant selection.

It appears, however, that "the war of Nature is not incessant" (p. 61), and also (from the text of the diagram) that variations occur "often after long intervals of time" (p. 90), notwithstanding the fact that there is much superficial probability in the theory that variation is necessarily contingent on reproduction (ii., 239, 240). Moreover, although "mere lapse of time by itself does nothing" (p. 82, &c.), yet every form will, during each successive age, have to be slightly modified" (p. 308).

An Exegesis of the diagram may illuminate matters. Its construction betrays care. The relative length of B, C, D with G, H, and B, C, D and G, H *inter se;* the extension of F to F^{14} rather than of E to E^{14}, correspond with the text. If of a dozen species, a couple alone were ever beset with favourable variability never witnessed by their fellow-species during an aggregate existence of 36,000 generations; and if by an acceleration of variability the fourteen new forms were ever evolved from five in less than half the number of generations taken by the five to diverge from two, then the diagram corresponds with Nature.

14. "We clearly see that the nature of the conditions is of subordinate importance, in comparison with the nature of the organism, in determining each particular form of variation; perhaps of not more importance than the nature of the spark, by which a mass of combustible matter is ignited, has in determining the nature of the flames" (p. 8, ii., 281, &c.). As already stated, this section is really one with 12.

15. "Every variation is either directly or indirectly caused by some change in the surrounding conditions" (ii., 415). "These several considerations alone render it probable that variability of every kind is directly or indirectly caused by changed conditions of life. Or, to put the case under another point of view, if it were possible to expose all the individuals of a species during many generations to absolutely uniform conditions of life, there would be no variability" (ii., 242). Such changes, however, operate as a rule not upon the varying individual itself, but upon the parents or their reproductive organs (ii., 35, p. 260; *cf.* ii., 257),

while probably the commonest mode of action is upon successive generations ("two, three, or more," ii., 258); "changed conditions requiring a long time for their cumulative action" (ii., 39, &c.), it is "more especially its ancestors" who are influenced (ii., 241).

There is "some probability in the view propounded by Andrew Knight, that this variability may be partly connected with excess of food (p. 5). "Of all the causes which induce variability, excess of food, whether or not changed in nature, is probably the most important" (ii., 244).

I apprehend that—whatever may have determined the site of Mr. Darwin's TOMB—a recognition of the service rendered to Science by the promulgation of this theory, that from one to at most ten pre-Cambrian, presumably unicellular, organisms, created and vivified by the Creator's breath, have arisen without any subsequent interference, and we can hardly believe otherwise than without beneficent guidance, the structures and the bodily and mental activities of all organisms, by the accumulation, mainly by natural selection, of variations so minute as to be appreciable only to well-trained eyes, occurring in correlation but not in coordination with related variations, affecting single individuals, inducing intermittent modification, and being determined in their nature by an innate idiosyncratic plasticity, the chief ultimate cause of which is probably the accumulating action of changing conditions upon the parents, but more especially remoter ancestors, of the varying individual,—contributes to place his STATUE in the British Museum (Natural History); and that should any characterisation of this theory and its advocacy by its author and his adherents with justice assimilate, or even approximate, in severity such remarks as may be fitly made concerning the Bacon and Leibnitz quotations, the promoters of the memorial may some day be ashamed.

V. OUR MEASURES AND OUR STANDARDS.

By Louis D'A. Jackson, C.E.

THESE two subjects, though certainly inter-dependent to a very great degree, may be considered distinct and separate; or, if the whole be treated as one subject, the distinctions in its two branches should be perpetually borne in mind, more especially in reference to practical effect.

Our Measures are, for all purposes of measuring and weighing (that is, measuring by weight), the best existing national set of measures in the whole world, for the reason that a suitable and convenient Unit is provided for every ordinary want and purpose—a grand advantage that preponderates over all defects. Our Standards, or, to speak more precisely, the arrangements of standards, are worse than barbarous; for they constitute a spoilt and degraded barbarism, in which the simplicity, the forethought, and the scientific beauty of the original system have been vitiated or obscured.

The question then arises, "Does progress then consist in revivalism?" and it is difficult to answer it in the affirmative without much reserve and many limitations.

But before proceeding to treat of the need of these limitations, and their inducing causes, let us also notice the grand difficulty in dealing with the one subject singly or as a whole. It is a dilemma of the following form:—

With the masses our Measures constitute an inheritance of the same sort as our language, our customs, manners, habits, and institutions; and this reason is alone sufficient to deter them from parting with any of them, while a sweeping change would be strongly resisted. Hence if scientific men, understanding the want of system in our Standards, in their mode of determination and construction, and in their inter-dependence, should propose any interference with them in any way, the undiscriminating public immediately jumps at the conclusion that the existing measures will be altered. It certainly might be so, though we shall later show that it is not inherently necessary that it should be, and, besides, explain that it can be avoided through the exercise of some additional care and management. But the *prima facie* argument against all such improvement generally resolves itself into "Hands off from

the Measures, as you would create more work for the Standards Office"; or, "Do not interfere with the Standards, we cannot spoil the Measures of the nation."

The dilemma is apparently triumphant for the anti-progressists; actually it is not. Beyond it comes the insufficient argument "Let well alone," to which we reply we are willing to do so, but do not agree to "let bad alone." Also there is Mr. Gladstone's argument: "We have at present more important matters requiring attention," &c.—a plea for perpetual inaction with regard to any subject at all periods, that fails to justify dawdling and neglect. This, too, forces us to the conclusion that a permanent Board of Examiners should be specially constituted to deal with the large number of measures affecting the public welfare, convenience, subsistence, and progressive development, that are not sufficiently interesting to parliamentarian and party politicians.

But to return to the main subject,—the amount of necessary improvement in our Standards and their systematisation.

A mere collection of Standards, as simple representative units of measure for purposes of reference in comparison, does not satisfy the just demands of the nation; it is necessary that their inter-dependence throughout should be formed on some clear simple principles, in order to frame a system; otherwise we cannot compute or pursue calculations involving units of different sorts without needless labour and risk of error. Now calculating is as much a necessity of existence as measuring, and a system of Standards should be rendered fully suited to both purposes, for twenty-six millions of human beings should not be condemned to perpetual needless calculation, whether it be on the binary or on the decimal system.

The principal hindrance to easy calculation consists in the want of simple inter-dependence between the various classes of measures—the classes of length, surface (cubic or solid), weight, and capacity; hence when we proceed to compound classes—as power, pressure, irrigation, and many other compound terms of importance in Statistics, Returns, &c.—the difficulties cease to be inconveniences; they become serious stumbling-blocks, which cannot be removed until the first five classes are properly systematised.

There is only one general method under which this can be done—the geometrical method.

Some simple standard unit of length, when squared, should form a standard unit of surface; when cubed, should form a standard unit of cubic measure when solid, and a

standard unit of capacity when hollow; fifthly, the corresponding basic unit of weight should be the contents of the unit of solid or hollow measure, in some simple substance suited to the purpose, either solid or liquid.

The first point is, "Have we already any unit geometrically dealt with in the mode above described?" The categorical answer is, "No." The more correct answer is, "Nearly so, but spoilt by the mode of determining the Standards; and it exists in only one instance."

We have a foot, a square foot (perhaps, though there is some doubt as to its visibility); the cubic foot in a solid form may also exist; there is a capacity foot, in the form of a cylindrical metal bottle, termed a cubic foot measure; fifthly, there is Miller's foot-weight, or a bronze weight that is supposed to represent the weight of a cubic foot of distilled water at its utmost density, though it actually does not.

Our five Standard Units are a miserably imperfect and incorrect set: if the object had been to scamp the work of construction and comparison as much as possible, that object is realised. We do not even know with any certainty whether the simple foot in length is correct to old patterns, or, if so, to how many and to which? Probably it is merely the third of a yard shown on an old parchment record in which the dividing lines are tolerably large holes. The square foot might perhaps not be very useful if made to a correct standard, but it or some multiple of it might sometimes be of use, and should certainly be at least constructed as a Standard for reference, as well as for affording facilities in constructing a true standard cubic foot. The solid cubic foot may exist as a Standard in metal, but it is very doubtful whether it exists in glass or in quartz, or any non-corrosible material, so as to be fit for the ulterior object—that of aiding in the direct construction of the capacity foot or hollow cubic foot, and in that of the foot-weight. The hollow cubic foot, which should form the basic standard of capacity measure, certainly does not exist in the form of a metallic cylinder, resembling a tea-urn, but apparently not at all in its proper cubic form. It also appears that it was never constructed direct from the linear foot—that was perhaps too much trouble: the construction was based on a computation of what it *should be*, and perhaps also on an erroneous foot-weight; in other words, the direct construction was entirely avoided. Miller's foot-weight, as everyone knows, was not made from an actual cubic foot of water; he simply made a bronze weight of 62·32106 pounds avoirdupois, a quantity he had calculated to represent it.

We notice that direct construction has been avoided as much as possible in these Five Basic Standards; the only remedy is to have them made again, without this painful scamping of work, and the sooner it is commmenced the sooner we shall have a calculable system to deal with.

There are two points that require further comment. First, that of the comparison of weight and capacity and cubic measure by distilled water at its maximum density. In the abstract it is perhaps not the best means; it is however an admitted mode with which the public are perfectly familiar; it is also supported by the prescribed custom of denoting specific gravities of solids and liquids by comparison with that of distilled water at its utmost density. These two advantages tell heavily in favour of its retention for the present. Secondly, as to standard temperature; there's no doubt that two temperatures, one for the vessel or units of material, and another for the water used, constitute a complication. One single temperature should be used throughout for everything. Every possible source of derangement in construction should be avoided, as well as that of falling back on computation; and as air-displacement is to be avoided, a vacuum becomes necessary during some of the work.

Imagining now that our Five Basic Standards shall be correctly reconstructed, we shall then not have altered any of our measures. This is generally admitted for the reason that the changes effected will be small, perhaps $\frac{1}{2}$ per cent, and the trading communities and the masses do not object to this—they do not call it an alteration but a re-adjustment which they would quite ignore, although it would be a boon to scientific men.

The ratios of all our commercial units with regard to these Five Basic Standards can then be accurately determined in their five several classes. However incongruous they may be, we shall no longer be kept in the dark about their true relations to each other throughout; the result will be a system instead of a collection.

Are we to end there? Not quite. First, we now have, it is true, an Act permitting decimalisation on any unit of English measures, but this Act is rendered nugatory by other Acts that make non-decimalised units compulsory, as, for instance, compelling distances to be mentioned in miles, furlongs, and yards; three units in each distance; similarly with other things. We require full effect to be given to the Permissive Act; our calculations can then be simple and comparatively easy, even when the compound units of modern invention are dealt with. While the Measures of Trade thus

remain practically unaltered, the scientific man and the calculator will be able to set them on one side in most of his work, without the degradation of adopting French fashions.

Next as to the multiples and submultiples of our commercial units. They will probably fall eventually into a mixed decimal and binary scale, formed on the *to be improved* five basic units, at some time when the masses and the tradesmen require this change; but it is not the duty of scientific men to press it on them against their will. Why should any interference with them be necessary? The object of this article has been to prove that it is not. The connection between the foot-weight and the ounce avoirdupois being millesimal, or very nearly so, this advantage will probably be utilised and enlarged upon in future development, not only by the scientific man, but also for commercial purposes.

Having thus run through a practical proposal, we can see the difficulties of anything like a complete revivalism of our very ancient measures at the present time. We are forced into legislating for ourselves and for our own time, whenever we can legislate at all.

ANALYSES OF BOOKS.

Hygiene; its Principles as applied to Public Health. By E. F. Willoughby, M.B. London and Glasgow: W. Collins, Sons, and Co., Lim.

This work contains so much matter of sterling excellence that we are tempted to overlook the beginning and end of the preface, in which the author bows down to the educational Moloch of the present day.

The first section of the book deals with dietetics. Here, in speaking of the carbohydrates, the author might usefully have referred to the doubts which have lately arisen whether beet-root sugar is really identical with the saccharose of the cane, or whether it is not a distinct product, betose, possessing the same percentage composition, but differing physically and physiologically.

The question on what the efficacy of anti-scorbutics depends is discussed at some length, and is left, from a theoretical point of view, undecided, though, as the author remarks, no difficulty is felt in practice. May not a part of the immunity which seafaring men enjoy in comparison with their predecessors be due to the fact that sea-voyages are now very much shorter than was the case before the introduction of steam?

Dr. Willoughby asserts that potatoes contain no acid. But if he will cut a raw potato, and apply a piece of blue litmus-paper to the freshly-cut surface, he will be convinced of his mistake.

In considering the potential energy contained in food the author shows the erroneous nature of Frankland's estimates. He quotes this chemist's figures, however, drily remarking that "questions on them may be given in examination-papers." He adds that "since it has been proved that starch is more easily metabolised than fat, the fancied superiority of the latter as a source of heat must be rejected as erroneous."

Few among the general public will be prepared to hear that veal-broth contains more nutriment than mutton-broth or beef-tea. It appears that "at the Munich hospitals, where dietetics are studied more scientifically, perhaps, than anywhere else, veal minced and cooked with meal is much used for convalescents."

Concerning the cereals Dr. Willoughby states that a great part of rye-bread, when eaten, passes off undigested. Oatmeal was, he considers, an excellent food so long as milk could be had *ad libitum*, but without this accessory it is much less valuable. Maize he pronounces to be, of all the cereals, the nearest

approach to a perfect food. It is to be regretted that obstinate prejudice prevents its use for human food in Britain. The potato he places low in the dietary scale, and deplores the fact that English people look on all other vegetables as mere luxuries. The lentil he considers the most nutritious, as well as the most digestible, of all forms of vegetable food.

When speaking of alcoholic drinks, the author points out that no natural wine can contain more than 14 per cent of alcohol, since at this point fermentation is arrested. He denounces the increasing use of the rank, coarse potato-spirit of Prussia, loaded with "fusel" for the fortification of natural wines and the manufacture of totally spurious ones.

On the subject of alcoholic drinks Dr. Willoughby takes a judicious mean path. Whilst utterly condemning their common random use, especially on an empty stomach, he insists that they have their time and place. Alcohol "undoubtedly checks metabolism, and much nonsense has been written on this point, even by such men as Dr. A. Carpenter, as if this process could not be too active." The fallacious character of the conclusions of Lallemand, Perrin, and Duroy is shown. These experimentalists, "if they deserve the name, dosed men and other animals with enormous quantities of alcohol, and because they could detect a certain quantity in the urine, &c., inferred that none of it was consumed."

Cocoa, when freed from a portion of its fat, the author considers almost a perfect food, but he deprecates the common practice of mixing it with starch.

He protests against the common and increasing use of ice and iced water, which interfere with digestion, and may even give a serious shock to the nerve centres. At the same time he exposes the fallacy that ice-water is always pure. It once fell to our lot to examine the feasibility of a scheme for purifying the sewage of large towns by freezing. We found that the ice retained a large share, not only of the suspended, but of the dissolved pollutions.

The nutritive value of Liebig's extract of meat is pronounced less than nothing, since its constituents actually accelerate metabolism.

On the use of milk the author gives the caution that foot and mouth disease is directly communicable by this secretion. As regards tubercular disease the evidence is less decisive, though there is strong reason to believe that danger really exists if the milk is used regularly. The flesh of animals "should be condemned unconditionally when evidence is had of cattle plague, epizootic pneumonia, sheep-pox, acute rheumatism, pig-typhoid and scarlatina, erysipelas, anthrax, and trichinæ."

Under the head of adulteration our author shows the shortcoming of the existing laws. Thus no action can be taken against the vendors of the so-called "French Coffee," or "Coffee as in France,"—the most disgraceful falsehood uttered since Chaucer

first denounced a shopkeeper as "much a liar"—though 75 per cent of the article is chicory, and not coffee at all."

In speaking of "butterine" Dr. Willoughby makes no mention of the circumstance that the fat of diseased animals is often used in its manufacture without having been subjected to a temperature sufficiently high to ensure the destruction of microbia.

On the subject of water we meet with the very questionable statement that the water supply of Paris far surpasses that of London in purity. At the present time there are complaints of fæcal matters present in the Paris water, and the question is raised of a fresh supply from some distant springs.

The author does not accept the statement that a river, once polluted with sewage, is incapable of self-purificaion, and gives an official account of the state of the Seine, above and below Paris, to prove his case. He holds—and justly—that "a mere trace of albumenoid ammonia derived from enteric and choleraic stools teeming with bacteria may be more dangerous than a hundred times the weight of healthy fæces, or other animal or vegetable matter."

We regret that space does not allow us to carry any further our examination of this most valuable work, which is in small compass an encyclopædia of public health.

Chemical and Physical Analysis of Milk, Condensed Milk, and Infants' Milk-Foods, with special regard to Hygiene and Sanitary Milk Inspection. A Laboratory Guide, developed from Practical Experience, intended for Chemists, Physicians, Sanitarians, Students, &c. By Dr. NICHOLAS GERBER. Translated from the Revised German Edition and Edited by Dr. HERMANN ENDEMANN. New York: the Author. London: Trübner and Co.

THE author of this valuable manual, judging from his preface, makes a point of rejecting the methods for milk analysis known and used prior to 1877, and proposes others as superior in accuracy, simplicity, and economy of time.

Dr. Gerber enters upon his task by giving a description of normal cow's milk, and noticing the physiological and other causes influencing the character of the secretion. Here it may be remarked that in spite of the great attention which has been drawn to a subject of so great agricultural and hygienic importance, all the circumstances of the case have not been fully studied. Thus, concerning the changes which occur in milk when cows are in heat, the author admits that but little is known. He informs us that after a certain age the yield of milk diminishes,

but he does not—as far as we see—throw any light upon the possible changes in its quality. This is the more to be regretted, since the opinion prevails that the milk of aged cows has a tendency to occasion phthisis. Decisive information on this point would have been very valuable.

The influence of meteorological phenomena on the yield and quality of milk, we are told, has yet to be examined. "Hard work," it is stated, impairs the quality and reduces the quantity of milk. This is a consideration which has no practical interest for the English reader.

In a section on the colour of milk it is remarked that deep blue spots are sometimes produced in milk by a certain fungus. The pigment generated appears to border closely upon triphenylrosaniline.

As to the microscopical examination of milk, the author considers that it can merely furnish useful indications for the detection of morbid changes or for the determination of adulterants. The lower organisms present in milk are *Mycoderma lactis*, *Mucor racemosus*, *Penicillium glaucum*, *Dictyostelium mucoroides*, and various species of bacteria, vibrio, zooglœa, and monads. Hence no one need wonder that milk may be the medium of transmitting infectious diseases. It is thoroughly established that microbia present in the water drunk by cows may reappear in their milk. Other channels of infection are impure water used to adulterate milk, or even to wash out the cans. Milk whilst stored in dairies has been found to absorb and communicate the virus of typhus and of scarlatina. Dr. Gerber is of opinion that the milk of cows suffering from foot and mouth disease and from cattle plague is not rendered safe by boiling. He protests against the use, in the diet of milch cows, of distillery swill, brewers' grains, and other fermenting matter. He rightly suggests that the supervision of milk should extend to the animals themselves, their food, water, and housing.

As regards adulteration, the author is of opinion that dealers mostly confine their operations to watering and to the addition of skim-milk to new milk.

Concerning sheeps' milk we find the following curious remark:—"The many points which mountain dairies and the dairies of the marshy, flat lands have in common is also illustrated by the fact that sheep are kept for their milk in Holland."

In speaking of condensed milk the author exposes a vulgar error. He writes—"It is simply a prejudice that Swiss condensed milk should, as regards richness, possess superior qualities. Considerable stress is laid on the superior quality, especially as regards flavour, of the milk of cattle fed on Alp mountain pasture. If we consider, however, that the establishments which manufacture condensed milk are not only situate in the valleys, but use exclusively, as they do everywhere else, milk produced in the valleys, the ridiculousness of the claims made are at once apparent."

It is stated that among the varieties of condensed milk is one in which salt is partially substituted for sugar. In France there is even, *horribile dictu*, milk condensed with the addition of tar, coal or wood!

In the instructions for examining human milk we find it stated that "Woman's milk differs from the milk of animals, especially cows." We must here ask whether the milk of animals belonging to the order of Primates, and especially of the anthropoid apes, has ever been fully examined?

The author's suggested rules for a rational milk inspection are admirable, and we should greatly like to see them officially adopted in England.

The only defect of this book is that it is written in very imperfect English.

Expository Thoughts on the Creation. By James Robert Smith. London: Elliot Stock.

We have here one of the many attempts at reconciling the teachings of modern Science with the Hebrew cosmogony. The author confesses to a lack of sufficient knowledge of Natural History, and pleads that neither leisure nor learning (properly so called) has been brought to bear upon his undertaking. He admits, further, being "no Hebrew scholar."

In an early part of Mr. Smith's treatise we further find him recording his opinion that "the Bible was not written to teach Nature's facts and laws and workings." This is the very view which, since the days of Giordano Bruno, and of Galilei, has been held by men of Science in general. Rightly understood, this view renders all inquiries as to the harmony and disharmony between Science and Revelation a mere waste of time. Mr. Smith, however, does not feel the the full force of the admission, or he would—rather he *could*—have proceeded no further.

The first chapter, entitled "Observations and Conclusions respecting the Authors of Creation," lies entirely outside our competence. We can merely intimate that the author takes up a position which a few centuries ago would have been perilous in the extreme. Even in our days it may give occasion to much inkshed should it attract the attention of professional theologians.

In the second chapter Mr. Smith takes up what he calls "the much-vexed question respecting the length of each period translated in our English Bible 'day.'" To the man of Science who takes his stand on the simple principle above laid down, this is no question at all. The author conceives, as have done others

before him, that the days of creation were periods of considerable length, to each of which he assigns the length of 100,000 years. The reasons assigned for selecting this precise length of time seem to us highly fanciful. Thus we are told that the five ciphers placed at the right hand of "the emblematical unit 7," in order to give the earth's total existence of 700,000, "may symbolise the five senses of all the higher genera of animals, as well as the elements of general nature, inanimate and animate and organic." The "compound elements" of Nature were aëriform vesicular matter, wind, watery vesicular matter, oleaginous vesicular matter, and salt."

To find wind classed as an element is indeed bewildering, and we ask, though in vain, for any evidence upon which such a classification can be built.

In succeeding chapters we find, however, much more that is perplexing. Thus we read of "the primordial pair of the second genus of metals, namely, copper and brass." "Taking lead and tin, copper and brass, pig-iron and dense iron as being respectively natural pairs, as I contend that they are, lead, copper, and pig-iron were accordingly formulated in the northern hemisphere, and tin, brass, and dense iron in the southern." Leaving out any remarks on finding the well-known alloy brass classed with simple metals, we may well ask in what part of the southern hemisphere it occurs in Nature? We may likewise ask whether, surface for surface, copper is not equally plentiful in the south as in the north?

The mystery is how any man of evident culture, and of thoughtful, intellectual habits, can entertain such notions as we find scattered on almost every page of the work before us? This difficulty hinges, doubtless, on the peculiarity of English education, which, until lately at least, allowed the middle and upper classes to grow up in the grossest ignorance of *things* in contradistinction to phrases.

Journal and Proceedings of the Royal Society of New South Wales for 1883. Sydney: Richards. London: Trübner and Co.

The Anniversary Address, by the President, Christopher Rolleston, contains a feature which will now appear strange to many persons in the Home Kingdom,—we mean the most eloquent tribute to the memory of Charles Darwin. So much rubbish—we use the word advisedly—is now obtruded upon the world that even the death of our foremost *savant* and the mighty lessons of his life are fading into obscurity. We have heard it

hinted that had the "Origin of Species" been first published at any time during the last eight or nine years it would have met with little attention, save among professed naturalists.

We must call particular attention to a paper by Mr. Peter Beveridge, on the "Aborigines inhabiting the Great Lacustrine and Riverine Depressions of the Lower Murray, Lower Murrumbidgee, Lower Lachlar, and Lower Darling." It is here remarked that "a sting from a deaf adder is considered by the natives hopelessly fatal; therefore they rarely attempt the extraction of the deadly virus injected by that reptile's horny tail spur: in fact they have not any time to try a cure, for the victim seldom lives twenty minutes after being wounded. These reptiles are the most dreaded of all the snake kind by the aborigines, on account of their superior virulency. To add to the danger arising from these reptiles, nothing will move them from the position in which they are met. If one is touched by a careless foot, or even by a piece of stick, as he lies in the path, he does not crawl away from the interrupting object as quickly as possible, as is the manner of most reptiles; he merely raises his head and tail simultaneously, and, with the rapidity of thought, seizes the disturbing object with his mouth, holding firmly thereby, whilst he drives his tail spur into it repeatedly." Here, then, we have a nameless snake, fully as deadly as the cobra, but anomalous in as far as its venom is secreted and emitted not by glands in the head and hollow teeth, but by a special organ at the tail. Further investigation is here surely needed.

According to Prof. Liversidge, Mr. Brown, a Wesleyan missionary, brought from New Britain a soft white limestone, physically and chemically undistinguishable from chalk. He now exhibited specimens of flints from the islands of Ulana and Ugi,—an additional proof of the probable presence of true chalk of the Cretaceous age in the South Sea Islands.

British Fresh Water Algæ, exclusive of the Desmidieæ and Diatomaceæ. By M. C. Cooke, M.A., L.L.D., A.L.S. 2 vols., 8vo., pp. 330. Plates 130. London: Williams and Norgate, 1882 to 1884.

This magnificent work, of which the first two parts have already been noticed, has at length been completed, and there is no reason to alter the favourable opinion then expressed. ("Journal of Science," vol. 4, p. 263).

The separation of the "Fresh Water Algæ" from the numerous Marine species is purely a matter of convenience, and as the

author states, "is confessedly an artificial arrangement which demands apology, but can scarcely receive justification. The only excuse which can be offered is that it serves the purpose of those for whom the present work was written, namely, the microscopists who desire some acquaintance with the organisms met with in their excursions to ponds and ditches. This class of students certainly deserve such assistance: their limited time for study is mostly spent at the microscope, or out of doors collecting specimens, rather than in searching through libraries and overwhelming masses of periodical literature. They work earnestly and yet leisurely, and not having to cram for passing examinations, dispense with the services of the professional coach; if the aid of someone knowing more than themselves is needed, it is found at one of the natural history societies which now abound all over the kingdom, and the strange specimen sooner or later reaches the hands of an expert, who is able to tell something about it, or still more humbly to say he does not know, and advise how further research is to be conducted. Those who have had the good fortune to meet the author of the present work either at the Quekett Club or at one of his excursions, will know how to value the instructions and hints of so genial a teacher—one who loves science for its own sake.

The introduction contains a concise history of the subject, from which it appears that in Ray's time about twenty species of Fresh Water Algæ were known; these had increased to eighty-eight at the publication of Dillwyn's "British Confervæ" in 1809.

The next important work was Hassall's "Fresh Water Algæ," published in 1845, containing descriptions and figures of two hundred and ninety-seven species. Since that time the student in search of information respecting these organisms must have sought for it through the over-increasing mass of scientific periodical literature. The present work contains descriptions of four hundred and thirty-eight species. Respecting the omission of the Desmidieæ, the author must answer for himself. "This large and interesting family is designedly excluded, as it is proposed to treat them separately. As so many students confine themselves exclusively to this family, this proposal will doubtless commend itself. The excellent text-book by J. Ralfs has long been the standard for English students, and would be so still but for its scarcity and the large number of additions in the interval since its publication." Similar remarks will apply to the more numerous family of Diatomaceæ. The coloured plates are beautifully executed, and in many instances are from the author's own drawings, in which case the magnifying power invariably accompanies the figure.

A list of the authorities quoted, and what is even more useful to the readers for whom the book is intended, a well-compiled glossary, form part of the work.

While congratulating the author on the completion of his book,

it must be acknowledged that, although it has come to an end, it is evidently not finished. No one can read it carefully without thinking that, although much has been done during the thirty-nine years which have passed since the publication of Hassall's book, as much, or more, remains to be accomplished. The Palmellaceæ, Protococcaceæ, and Chroococcaceæ will furnish plenty of work for years to come to any who will devote time and leisure to cultivating, watching, and working out their life-history. Such patient and exhaustive research as that of Messrs. Dallinger and Drysdale on the Monads, applied to the investigation of any of the lower and little known organisms, must, in time, yield equally valuable results. Many of the forms included in the above-named families will probably be found to be only immature orms of other algæ or lowly organised plants.

The Agnostic Annual, 1885: London: H. CATTELL AND CO.

AMONG the essays in this annual of intensely heretical repute four at least especially claim our notice. The first, and perhaps the foremost of these is "Pessimism and Physiology," by C. N.—a refutation of the philosophy of Schopenhauer and his imitators. The author does not accept the view that this is the worst of all possible worlds; but neither, as far as we can see, does he advance the inverse proposition. Either of these extreme views can be held only by non-observers who have never risen to the wisdom conveyed in the homely old proverb, "it's an ill wind which blows nobody good." We might ask both optimist and pessimist what world do they mean? The world as it has been, as it is, as it probably will be, or as it might be if man would put even his scanty present knowledge into practice? We see changes for the better, due to man's awakening intelligence and moral sense, and proving that the world cannot previously have been the best possible, since it has proved capable of emendation. We see, on the other hand, changes for the worse, due to man's greed and ignorance. We see forests destroyed and the climate of extensive regions altered for the worse by the simple introduction of goats—animals which, as Sir Joseph Hooker informs us, have occasioned far greater desolation than has been due to war. We see other countries made fit only for the dwelling of demons by the coal-smoke and other products of modern industrialism—proof sufficient that our planet previously cannot have been the worst of all possible worlds, since it has proved capable of so much and far more deterioration.

Or, if we may take the common pessimist formula that "life

is not worth living," there is room to ask "to whom?" Certainly not to all the many who are in harmony with the spirit of the present age, whose aim is high living, and low—very low—thinking, very well content with "business" during the day, and Little Bethel, or the tavern parlour, or the parliamentary debating society at night.

C. N. points out that "very little pleasure is felt in connection with continuous organic functions unless they have been interrupted by ill-health or abstinence. There is little delight in normal muscular activity, or in deep drawn breaths of fresh air, except to the invalid who has long been pent in a sick room."

Most true; indeed the portions of our bodies susceptible of pleasure are few and small, whilst the great rest exerts its functions when in health without our consciousness.

He continues: "The darkest, the most logical, the most absolutely immoral form of pessimism is sponsored by Calvin. But the exile of the middle ages is over long ago; the husks which the swine did eat are forgotten; even the good father is superannuated, and we are striving chiefly to retain faith in the fatted calf."

What a truthful picture!

He continues: "World-weariness sets in, and with it a new form of pessimism, more subtle, and perhaps more paralysing. Yet the doctrine of Schopenhauer can scarcely be called *new*, seeing that it is in reality a one-sided presentation of a religion more ancient than Christianity. Having worn out the first suit of mourning which we borrowed from the East, forthwith we proceed to borrow another, different in pattern, but equally dismal. St. Paul gives us over to Buddha." From the East!

> "Ach, des Lebens Blüthen sind verfallen
> Vor des Ostens melancholisch Wehen."

C. N. ably maintains that the existence and development of conscious life on the earth cannot be comprehended save on a theory the very opposite to that of Schopenhauer. "Evolution has been possible because sentient beings have, on the whole, liked life, and taken delight in the exercise of their faculties."

Under the strange title, "Mars' Hill in London," Mr. Moncure Conway notices the recent encounter between Mr. Herbert Spencer and Mr. F. Harrison, and the summing up of Mr. Justice Stephen. Mr. Spencer admits that the "Unknowable" has nothing necessarily moral about it. Mr. Harrison might make a still wider confession concerning his Positivism, with its new God "Humanity"—almost too absurd to be capable of serious discussion. For what shall we say of a creed whose apostle Comte abandoned his devoted wife, who had nursed him through an attack of insanity, and formed a *liaison* with the wife of a convict?

"Agnosticism and Theism" is a kind of manifesto by Dr. W.

B. Carpenter, who objects to the standpoint of Agnosticism as "defective because it takes account of the intellect only," yet if obliged to choose between Agnosticism and Orthodox Theology would decidedly prefer the former."

But this short essay is noteworthy chiefly for its unconscious, and therefore inexpugnable, egotism. Dr. Carpenter writes: "When Agnosticism shall have produced any such philanthropic worker as Mary Carpenter, it may claim to be a motive power for good. As her brother, intimately conversant with her springs of action, I feel certain that nothing but her religious faith could have carried her through her life of struggle with the dead weight of ignorance and prejudice she had to encounter." It is not every writer who would have sought among "his sisters, his cousins, and his aunts" for a telling example.

"The Messrs. Facing-both-ways of Science" by Dr. Aveling is a severe, and as it seems to us an unjustifiable, censure of such scientific men as do not proclaim themselves atheists. All such are referred to the *genus* Humbug and the *species* Facing-both-ways. Within this species the author recognises the sub-species *Scientificus*, comprising again two varieties, *Indifferens* and *Religiosus*. To the former variety are referred "the great mass of our scientific men. Examples are the late Charles Darwin, and, among the living, Ray Lankester. At first I had written the names of Huxley and Tyndall; but, on reflection, these gentlemen were struck out, for they are such hybrids that it is impossible to classify them anywhere. Tyndall in one breath delivers a Belfast address and in the next informs an amused world, after a performance suspiciously like a prayer meeting, that he recants. Huxley writes boldly against Theism, and is then moved to an almost tearful anger when his views are made public." Dr. Aveling continues: "The characteristics of the sub-species Indifferens are as follows: entire unbelief in the supernatural at heart; respectability, fear of society; conformity to its usages; the idea that a belief in the supernatural is necessary for the lower classes; silence upon the fundamental questions at issue between the Theistic and Atheistic world. . . . We also know what the majority of our professors think of the Christian religion, and yet we cannot get them to speak out."

It may here be asked how the author knows so exactly what the majority of our professors believe? If, further, "we all know" their opinions, what more need for "speaking out" can remain?

If we, for argument's sake, suppose that the bulk of scientific men are, at heart, entire disbelievers in the supernatural, we can very well imagine them concluding that the progress of science is of vastly more moment than the success of an Atheistic propaganda, and keeping silence in the knowledge that any such "speaking out" would discredit science with the majority

of the nation. We endorse the plea which Dr. Aveling puts into their mouths only to over-rule, *i.e.*, "Their calling is that of investigating natural phenomena, and the conclusions to which they may have come *re* the spiritual are of no moment to any but themselves." It is easy to say, "Men are turning to the teachers of science to-day as they turned to the teachers of religion in the past."

Now the great error of these teachers of religion was that they assumed to lay down the law on all things. Men of science, more prudently, claim no authority beyond the limit of their own special studies. Sometimes, indeed, a mathematician or a physicist attempts to adjudicate on biological questions, with results which are anything but encouraging.

Turn we now to Dr. Aveling's second variety—"(2) *Religiosus.* Examples: Owen (palæontological), Mivart, and Beale. Its characteristics are as follows :—Belief in Christianity; dexterity in extorting harmonies between science and revelation; blindness to logical conclusions; a Gargantua's mouth for contradictions; membership of the Victoria Institute. This variety would not exist but for the fact that the variety *Indifferens* is in being. Its individuals are in the main Sunday-school teachers with a smattering of scientific knowledge." It seems to us that the three *savants* just mentioned, to whom may be added Wallace among the living, and Faraday and Clerk Maxwell among the recently dead, possess something vastly more than a smattering of scientific knowledge, and we fail to see their resemblance to Sunday-school teachers. Nor do we see in the least how they would be moved to renounce Theism if Ray Lankester, Huxley, and the majority of our professors were publicly to avow themselves Atheists.

The whole of this essay gives the most signal proof of the ability of the author, for whom our concluding wish is that he may do not less in scientific research than the men whom he pronounces "humbugs."

Our Corner. Vol. iv., No. 5, November 1st, 1884.

This issue is, to us, barren. Those able scientific articles contributed to former numbers by Dr. Aveling and others are here conspicuous by their absence. The present time of political excitement is no less unfavourable to science than it is to industry and commerce.

CORRESPONDENCE.

*** The Editor does not hold himself responsible for statements of facts or opinions expressed in Correspondence, or in Articles bearing the signature of their respective authors.

ELECTRICITY AND THE ANIMAL.

I HAVE read with great interest your remarks on Dr. Stone's paper on "Electricity and Health," which was read before the Society of Telegraph Engineers at the Health Exhibition; and also those on the experiments stated to have been made with artificial incubation, in the presence and absence of magnets.

At the meeting at the Healtheries I pointed out that probably the discrepancy in the measurements of the electrical resistance of Dr. Stone's 7 feet of clinical clerk, when measured with high and low tension currents, and more particularly the great apparent fall in the resistance when measured by means of the alternating current, might very probably arise from an opposing electro-motive force being measured as resistance.

I pointed out that in every part of the animal body we have an artery and a vein running side by side. When we pass an electric current through a portion of the body—say through a limb—the current passes along the two blood-vessels in the same direction with reference to the limb itself; but it must be remembered that, looking upon these vessels, in comparison with their surroundings, as conductors, each would create its own magnetic field in concentric circles round it, so long as the current was passing through it.

In each, however, the fluid blood—which is here the conductor—is, we know, in rapid motion, so that we may expect to have developed in each, seeing that it is a conductor moving in a magnetic field, an opposing electro-motive force, which I suggest is measured as resistance.

This supposition is borne out by the fact that with the alternating current, which we know creates but a comparatively feeble magnetic field, the measured resistance is strikingly reduced.

I believe I am correct in stating that we have no other case of a body altering its electrical resistance, without—either first or at the same time—altering some other physical condition, and therefore, it appears to me, we are bound to look further for a solution, and not to accept at once mere experimental facts, which do not agree, as proof of physical conditions in the animal body which do not exist in other bodies.

It may, of course, be objected that the magnetic field so cre-

ated must be exceedingly small. So it must; but the whole thing is very minute. The currents with which surgeons and others deal who apply electricity to the animal body are, I believe, the feeblest that are ever used. It must be remembered, too, that the conductors—the blood in the vessels—are moving very rapidly indeed.

I regard the experiment with the magnets and the eggs as bearing very strongly on the views I have put forward. Evidently the presence of the magnets produced some change in the embryo of sufficient importance, in many cases, to destroy life, and in others to interfere with the performance of the proper functions of the bird when hatched.

I suggest that the presence of the magnets in the neighbourhood of the eggs generated minute currents of electricity in the blood and other vessels, which acted detrimentally on the formation of the chick.

I would suggest, as an extension of the experiment, that magnets of different power be placed in the neighbourhood of separate eggs, sufficiently removed from each other to be independent in their action; and that the poles of the magnets, made small or large, as convenient, be placed in different positions with reference to each other and to the egg.

It appears to me that if the presence of a magnet can be made to act prejudicially on the embryo, it should also, by suitable arrangement, be possible to make it act beneficially.

Sydney F. Walker, M.S.T.E and E.M.I.M.E.

THE OPTICAL EFFECTS OF AN UNUSUAL POSITION OF THE HEAD.

Can any of your readers solve for me the following optical (or physiological?) problem? In my school-days, when taking a stroll with any of my companions, it was a common practice among us, on reaching any point where there was a wide prospect, to look at it bending downwards, and looking either between our knees or alongside one of them, the crown of the head being turned downwards. In this ungraceful posture the landscape appeared much more beautiful than when viewed in the ordinary upright position, everything appearing to have a warmer and richer colouration.

R. D.

[We should think that the effect must be due to a determination of blood to the head, caused by the unusual attitude.—Ed. J. S.]

Contrary to our usual custom we give replies to the queries of the following two correspondents :—

1. "VESLE."—Dr. R. Angus Smith's process for the detection of microbia in water is as follows :—In 100 grms. of distilled water, heated to +30° C., dissolve 2 to 5 grms. of very dry gelatin in thin leaves, and 2 centigrms. of sodium phosphate. Filter and precipitate with fresh albumen. Take in a test-tube 25 c.c. of this solution ; add to it an equal volume of the water to be examined, and keep the tube thus filled for some minutes in water at +35° C., to effect an intimate mixture. Stopper the tube with cotton-wool, and keep it for a few days in a warm room.

2. R. M. D.—We have it on the authority of eminent counsel that no learned society is warranted in giving the title of "Fellow" to its members unless it is incorporated either under a Royal Charter or under a special Act of Parliament. You have therefore no right to place the letters "F *x y*" after your name.

NOTES.

At a recent meeting of the Metropolitan Board Teachers' Association, which consists of 2078 head and assistant masters and mistresses employed in 320 London Board Schools, it was resolved unanimously—"That the Metropolitan Board Teachers' Association endorses generally the report of Dr. Crichton Browne on over-pressure and worry in schools, and further thanks him for his Report."

Says "Science":—"Now, Spiritualism is an evil in the world. In America it is a subtle and stupendous evil; a secret and unacknowledged poison in many minds, a confessed disease in others,—a disease which is sometimes more repulsive to the untainted than leprosy."

The American Ornithologists' Union has done two very sensible things. It has decided that the European house-sparrow is not an eligible bird in North America, and it has appointed a Committee for the protection of American birds and their eggs from wanton destruction.

The Rev. J. G. Wood comes to the conclusion that the musk beetle (*Aromia moschata*) has the power of emitting or suppressing its odour at pleasure, but that when dying the scent is continuous and very powerful. He gives a case in which a scent of roses is diffused from the human body in fatigue and weakness. "M.A. (Oxon)," commenting on this statement in "Light," gives some similar cases. (Considering that the mere displacement of a molecule may convert a stench into a perfume, and *vice versâ*, we need scarcely feel surprised if the emanations from the dying or the dead are sometimes pleasantly scented.)

"Cosmos les Mondes" gives, from an American source, a case of a tinned copper reservoir having been perforated by microbia.

The statement that ants formally bury their dead fellow-citizens has been confirmed by certain writers in the "Neue Züricher Zeitung." A Miss Hatton seems to have even witnessed the funeral ceremony.

M. Marey ("Comptes Rendus") finds a simple explanation for the more rapid spread of the cholera after storms and heavy rains. The excreta of the patients are often carelessly thrown into fields, gardens, yards, and even streets. Heavy rain may

easily wash the infectious matter into brooks, walls, &c., and thus spread the infection.

M. R. B. Roosevelt (American Assoc.) gave cases of hybridism between different species of Salmonidæ. He proved that a fish hybridism by no means necessarily implies sterility.

Rev. E. Hill, F.G.S. (British Assoc.) shows reasons for rejecting all the theories of the Ice-age, and considers that further investigations on the last series of changes in the outline of the continents of the globe should be undertaken.

R. von Lindenfeld concludes that the Glacial Period in New Zealand must have been very recent.

According to Prof. Storer carbonates of lead and baryta in a pure state are fatal to mice, but the addition of a small quantity of whiting rendered them both innocuous.

A French statesman, speaking on behalf of the proposed general Exhibition to be held at Paris in 1889, gravely asserted that France had, in 1855, given the first example of an international "Exposition." What of England and the World's Fair in 1851? Thus is history manufactured.

"Cosmos les Mondes" is filled with indignation at the proposed international adoption of the meridian of Greenwich, and suggests, instead, Rome or Bethlehem!

Prof. B. G. Wilder (American Assoc.) proved, by photographs and a preparation of the brain of a chimpanzee, that in the anthropoid apes the cerebrum extends over the cerebellum by at least a millimetre.

M. Boillot ("Comptes Rendus") calculates the specific gravity of liquefied oxygen as 0·888.

Prof. C. S. Minot (American Assoc.) considers the ovum to be homologous with the encysted protozoon, the zona radiata being equivalent to the capsule or cyst of the protozoon, and the contents being also homologous.

The "Medical Press and Circular" has an exceedingly able article on the present Examination-Craze.

"Cosmos les Mondes," in a memoir on the "inconveniences of the baccalaureat," shows how rarely men of original minds have earned scholastic distinctions.

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